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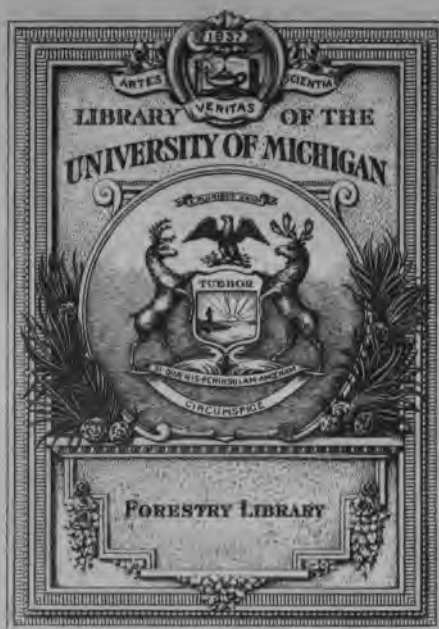


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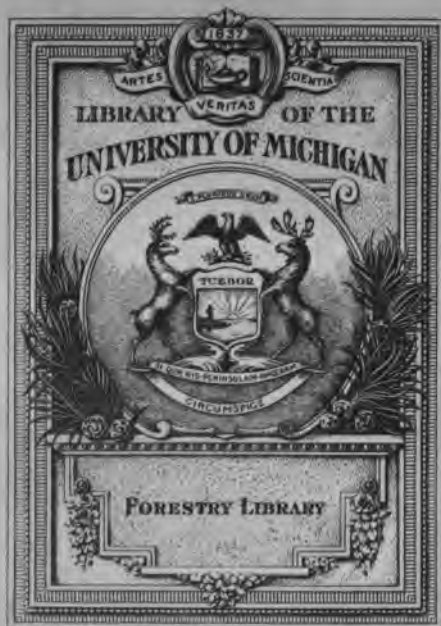


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GRAY SQUIRREL

ANIMALS

THEIR RELATION AND USE TO MAN

A NATURE STUDY TEXTBOOK

BY

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GINN AND COMPANY

BOSTON • NEW YORK • CHICAGO • LONDON
ATLANTA • DALLAS • COLUMBUS • SAN FRANCISCO

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PRINTED IN THE UNITED STATES OF AMERICA

826.12

The Athenaeum Press
GINN AND COMPANY • PRO-
PRIETORS • BOSTON • U.S.A.

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PREFACE

This little book has been prepared in response to the request for a full and complete presentation of the series of animal lessons as outlined in my course in nature study. From the beginning the aim has been to select lines of work that would render possible the development of an interest in the child's mind strong enough to endure beyond the period of school days. Finding that the child's interest naturally centered around common animals met in daily experiences, I adopted this point of view and commenced with the highest form of domestic animals, the horse, sure that in this accessible subject each child would be able to find an opportunity for independent observation work.

The subjects selected for the observation work have been taken from the more familiar animals, because it seemed wise to lead the country-bred child to know and appreciate his home surroundings, and to associate all domestic animals with such forms of wild life as were closely akin to them. On the other hand, the city-bred child who was familiar with the animals of the zoo needed to become acquainted with the common domestic animals related to them. The reading lessons that follow the study of each class or order of animals were written because of the difficulties experienced in finding suitable reading matter relating to the different subjects.

In its general plan the book presents each subject in such a way as to permit its being studied independently, or adapted to the time of year when the materials for observation can be most

easily secured, and yet leave the child with a clear conception of the general relation of a particular group to all other forms of animal life. The use of an outline of classification has been introduced, together with such definitions as were needed to explain the terms used, for the purpose of giving the child a basis for all his observations, and to train him to use simple scientific terms and to acquire right habits of study.

When Mr. William T. Hornaday's article, "Right Teaching of Zoölogy," appeared in *The Outlook* of June 4, 1910, his criticisms, based on the result of his own observations and experiences, served to strengthen the conviction as to the value of the order and method followed in presenting the subjects, for he says: "Through mistaken ideals and faulty methods the young people of America between the ages of twelve and twenty years are to-day being deprived of a great store of useful knowledge which by right is theirs, and which they should have. My contention is that to-day the need of the rising generation of Americans *is*, first of all, to acquire information about the wild life of our world that is worth knowing, and that they do not need to be trained as laboratory investigators, at the expense of practical knowledge in zoölogy.

"I believe that among the boys and girls of America the desire to know as much as possible about the wild animal life is very general. Every child is born with a love for animals quite as instinctive as its love for toys. Foster that desire at the proper time and in the proper ways, and we will have millions of genuine naturalists, each one deriving both pleasure and profit from the contemplation of wild life. The pupils desire and need to be taught about the birds of use and beauty, the big animals that are being so rapidly exterminated, the injurious rodents, the rattle-snakes and moccasins, the festive alligator, the turtle, and the once

cheap food fishes whose flesh is becoming dearer every minute. The way to give any pupil a general knowledge of the animal life of the world is to show good pictures of the objects that cannot be seen, and make a pupil learn from his own book the names of the animals and the simple English word that stands for the classification. Any pupil who will not dig out his lesson from a good textbook, with reasonable aid from the teacher, should be taken out of school and put to work.

"The amount of general knowledge regarding American wild life that countless thousands of Americans *need to know* as a business proposition is really great. By way of illustration, here are a few items: the birds that are useful to man and deserve protection; the birds that men and women are ruthlessly exterminating in ways that constitute a crime against nature; the mammals that are of most value and those that are of the greatest interest to mankind; the mammals that are most destructive to man's possessions and which need to be destroyed; the fishes that need perpetuation and propagation as a cheap food supply for the poor; the conservation of marine life generally; the reptiles that are deadly and those that are harmless; the reptiles that are useful to man; the insects that are injurious, and how to cope with them; the crustaceans and mollusks that can be cultivated and perpetuated by intelligent effort.

"These few items relate to the utilitarian or commercial side of life, but of themselves alone they are sufficient to demand a complete revolution in the method of teaching zoölogy. But there is another consideration quite as high as the utilitarian side of zoölogical knowledge, and that is, the duty of every intelligent American to obtain a good general knowledge of the most interesting animal species of his own continent, because of the immense amount of pleasure to be derived by him through that knowledge."

It is with great pleasure that I acknowledge my indebtedness to Mr. William T. Hornaday for his helpful criticisms and suggestions, which have aided in broadening the scope of these lessons and adapting them for use in any of the grammar grades, and for permitting me to make selections from numerous photographs.

The original drawings used to illustrate the observation lessons were executed by Mr. Eugene N. Fischer, of Jamaica Plain, Massachusetts. Mr. Edwin R. Sanborn, of the New York Zoölogical Park, supplied the photographs of wild animals that illustrate the reading lessons. I also desire to acknowledge the kindness of Miss Mary C. Dickerson, Mr. Clifton F. Hodge, Mr. Henry R. Linville, Mr. Henry A. Kelly, and D. Appleton and Company, in permitting the use of certain pictures, the acknowledgment of which accompanies the illustration.

I am especially indebted to Principal Arthur C. Boyden, of the State Normal School, Bridgewater, Massachusetts, for his criticism of the general outline; and to Miss Mary E. Trask, of the Normal and Training School, New Bedford, Massachusetts, for her critical reading of the manuscript.

CAROLYN D. WOOD

NEW BEDFORD, MASSACHUSETTS

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ANIMALS

A STUDY OF VERTEBRATES

CHAPTER I

HERBIVOROUS ANIMALS

In all probability the girls and boys who open this book are well acquainted with the cat, dog, and horse, since these are animals closely associated with our everyday life. Those living in the country have an opportunity to become acquainted with domestic animals, and to obtain, through experience, interesting information concerning some wild species. If, however, one lives in the city, the only animals with which it is easy to become familiar are those found at the "zoo" or circus.

In the belief that you all know something about some animal, and in order that each of you may come to a clear understanding of the extent of your acquaintance with animals, we suggest that you make a list of all those found in and about the place where you live, and keep a record of them in a notebook for future reference. Look upon this list as an inventory of the material with which you are to commence your observation work, and arrange it in two groups, one containing the animals that have a backbone (vertebrates), the other those that have no backbone (invertebrates).

When these lists are complete, turn to the outline of classification of vertebrates (p. 189) and find the characteristic covering

HERBIVOROUS ANIMALS

of each class. Using your notebook, group all the vertebrates according to their covering, under the following headings :

ANIMALS GROUPED ACCORDING TO THEIR COVERING				
Mammals	Birds	Reptiles	Amphibians	Fishes

Since the cat, dog, horse, and squirrel are mammals with which you are familiar, they have been selected as subjects for your first independent observation work. The following outline will suggest points which should be noted, because they aid us in discovering why mammals are divided into different orders.

Observation work. Watch the horse, to learn what he eats and how he eats. Watch the cat and dog, to see if they eat the same kind of food that the horse does. Do they eat their food in the same way that the horse does? Watch the squirrel, to note what he eats and how he eats. Which of these animals shall we call herbivorous? carnivorous? rodents? Examine your list of mammals and decide to which order the different ones belong. How does the foot of the horse differ from that of the cat or dog? Do all herbivorous animals have hoofs? Then in what other way might they be grouped? In your notebook make a record of the mammals grouped according to their food. If you find any about which you are uncertain, place them in the fourth group as subjects for special investigation.

MAMMALS GROUPED ACCORDING TO THEIR FOOD			
Herbivorous, also classed as Ungulata	Carnivorous	Rodents	Those that seem not to belong to these three groups

SPECIAL STUDY OF THE HORSE

Examine the groups of animals you have made and determine under which subdivision of each the horse belongs. This will show the most important distinguishing characteristics of the horse.

Under a picture of the horse make a record in your notebook of his distinguishing characteristics.

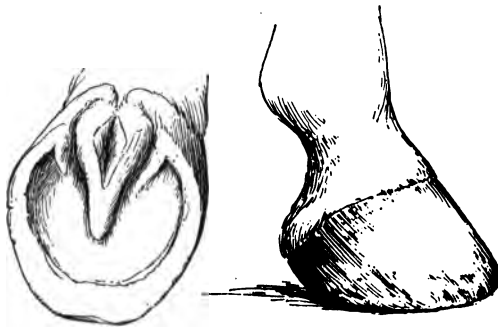
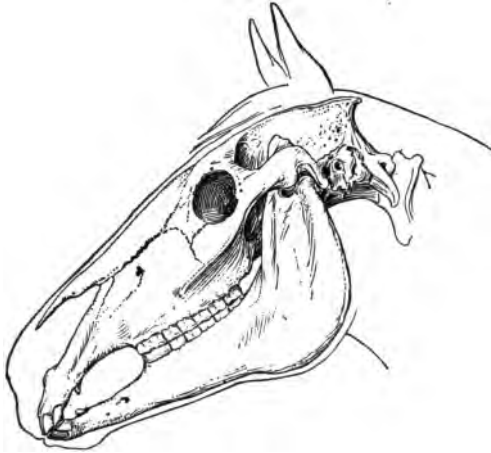
Observation work.

From observations and a study of the accompanying sketch determine the number and kind of teeth of the

horse ; think of the special use to which they are adapted. Watch the horses on the street and note the peculiarity of their lips and the way they are used to gather in food.

Make a record of the facts relating to the adaptation of the horse's lips and teeth to his habits of eating.

Watch the horses on the street for the purpose of observing where the legs are fastened to the body, and determine the number



of joints in each leg. Commencing with the first joint, or where they are fastened to the body, name the joints that correspond to those in your own leg. In this way see if you can determine which



CLEANING THE HORSE

are the true knee and ankle joints. Having located the ankle joint, find the toe joints and see how many toes the horse has. Compare the horse's hoof with the nails on your fingers, to note the position of the hoof with reference to the toe, and infer on which part of the toe the horse walks.

Copy the sketch of the horse's foot and record the facts that show the adaptation of the foot to his habit of walking.

Collect pictures of other domestic animals and wild animals that are like the horse. Mount these in your notebook.

Geographical distribution of the horse. Study some good map of the world and determine where in North America the horse would not be able to live on account of the climate and the food supply. In what parts of North America is the horse found? Why could the horse not live in the selvas of South America? In what other parts of South America could he not live? Why? What would prevent his living in the Sahara? in south-central Asia? In what parts of Europe is he unable to live? Why? Where in Asia is he found? Why could he not live in the central part of Australia? Why could he not live in high mountainous regions? Why are so few horses found in Japan?

Make a record of these facts in your notebook.

Questions for thought. 1. How are the horse's hoofs protected? 2. Why is this necessary? 3. What would happen to the hoof if it was not protected? 4. How are the shoes made? 5. How are they put on? 6. How long will they last? 7. What is the frog in the horse's foot? 8. Of what use is the frog?

Thus far your study of the horse has related only to certain facts that could be discovered through carefully directed observations. This study has helped you to understand the marked peculiarities of the horse and other animals like him. In your notebook you have recorded the names of these animals, both wild and domestic. Understanding why they are grouped as a *family*, you will be interested in stories relating to their early history, and the conditions under which they lived, for these show how certain habits that we notice in our domestic animals were formed.

THE HORSE

The horse is such a familiar animal that one never stops to question how or when he came to live with man. All that is known is that he is a descendant of the wild horse. When, by what people, or in what place he first became domesticated will never be known, as there are no records that tell the story.



SHOEING THE HORSE

It is just possible that the ancestors of our domestic horse came from the high desert regions of central Asia. So far as is known, this is the only place where true wild horses have ever been found. Some years ago a number of them were captured, and it was found that they differed from the domestic horse in having no forelock, a mane of short, erect hair, and no long hair in the upper half of the tail.

It is very difficult to capture these wild horses, because they make their home in the wildest parts of the desert. Owing to the lack of water in the summer, they must be hunted in the winter season, when the ice and snow will furnish the hunter with water. They are sometimes seen traveling in bands of from five to fifteen, each band being led by a single old male.



A THOROUGHBRED RACER

When the first explorers came to this country, no horses were to be found in either North or South America. The first were brought here by Cortés as a part of his army outfit when he landed in Mexico in 1519. The Indians, never having seen a horse, were terrified at his size and speed. At first they supposed that the horse and rider were one and inseparable. The story is told that

one day when the Spanish explorer Pizarro was attacked by hostile Indians, his horse became unruly and threw him. The Indians were so terror stricken at seeing the animal cast off what they supposed to be a part of his own body, that they turned and fled, leaving Pizarro in possession of their land.

We know that picture writing was one of the first ways of keeping records of events, and that this art of story-telling was practiced by the early Egyptians to such an extent that their monuments and public buildings were covered with picture writings illustrating the history of their country. From these pictured records many interesting facts have been learned concerning the horse. They show that from the beginning of history he has been intimately connected with the life of man. At first he was used only in war, where his speed and strength made him of great value, and his mere presence indicated that his owner possessed power and wealth. After a time wars became less frequent, and he was put to other practical uses, cultivating the soil, giving his speed and strength to aid man in his work, and serving as a means of transportation.

The long, plummy mane and tail which add so much to the beauty of the horse are shown to be the direct result of the care and attention he has received since he became domesticated. The wild horse, captured in Asia, and the domestic horse are distinguished from all other animals by the warts that are found on the inside of both fore and hind legs.

Although the horse of to-day is a descendant of the wild horse, yet in certain respects he differs from his ancestors. These differences are due either to changes in his food and surroundings or to the care he has received since he became domesticated. The proof that one such change has taken place can be found if we examine the foot of a colt; this will show the presence of two

slender bones called splints, which are supposed to be undeveloped toes. The presence of these bones is what has led to the belief that the ancestors of the horse walked on three toes instead of on one. By examining the teeth of a horse we can find evidence of another change that has taken place. Midway between the front



THE PRJEVALSKY WILD HORSE

and back teeth is a rudiment of a canine tooth, or tusk, as it is called. These tusks correspond to the great corner teeth of the dog, and show that there must have been a time when the ancestors of the horse needed them, either as a means of defense or for the purpose of catching prey.

If we study the horse thoughtfully, we shall discover certain facts that reveal something of the life of his ancestors. There is a part of the foot just above the hoof that yields a little at each step. This acts like a spring and saves the body from injury when the horse is traveling over hard, rough surfaces. This is what fitted the wild horse to live on the rough and treacherous surface of the open plains, where he had to travel long distances in search of food,



FAITHFUL WORKERS

and to depend on his speed to escape from foes. The necessity of feeling his way along as he traveled led to his forming the habit of trotting, or putting down only one foot at a time.

From the hour of his birth the legs of the colt are strong and well developed. When he is only a few days old he can travel as rapidly as his mother. There being no place to hide in the open plain, it was necessary for the wild colt to run as rapidly as the older members of the herd. Another thing that fitted him to do this was his peculiar habit of feeding. Instead of taking a full

meal as the calf or fawn does, the colt keeps running every few moments to his mother for food. This habit prevents his stomach from becoming so overloaded as to hinder his running fast, and shows that the wild colt was not in the habit of leaving his mother's side for any length of time.

The speed, strength, and intelligence of the horse have made him one of the most useful as well as the most indispensable among our domestic animals. The finest horses are raised in Russia. Germany ranks next in importance, while the United States is fifth as a horse-producing country. It has been estimated that four fifths of all the horses raised in the United States are used for agricultural purposes or as draft horses, the other fifth being used for private purposes. In all the countries mentioned special breeds of horses are raised to serve as war horses, as hunters, and as racing horses.

Even after he is dead the horse is of value to man, for there are certain tribes in the eastern part of Russia, and shepherds in the southern part of the same country, who make all their clothing from the skins of wild ponies. The Russia leather with which we are so familiar is made from the skin of the horse. In Uruguay a tallow made from horse grease is extensively used for lighting purposes, while in our own country the bones of the horse, as well as those of other animals, are used in the manufacture of soap.

THE WILD ASS AND THE DONKEY

The three most marked characteristics of the domestic ass, or donkey, are his long ears, his peculiar voice, and his obstinacy. Perhaps some explanation of these peculiarities may be discovered from a study of the wild animal. In all probability the ancestors of the donkey inhabited the mountainous table-lands to the south and east of Egypt, since great herds of wild asses are now found

there, where they must have gone to seek refuge when the larger carnivorous animals drove them from the jungles of the swampy lowlands. Scarcity of food caused the great herds to separate into smaller bands, the members of which scattered over a wide area. In the mountains they acquired the sure-footedness that in later years was to make them so valuable to man in carrying on traffic along precipitous roads.

In these new surroundings they found themselves in the midst of high rocks, where fitful winds blew and where projecting crags often served to conceal prowling enemies until they were within springing distance. Here, where the sense of sight and smell could be of little material assistance, keenness of hearing became of the greatest importance. One can readily understand how the long, movable ears of the ass would enable him to catch the slightest sound, such as that caused by the rolling of a loose stone down the slope, or a stealthy step among the rocks or shingles of the mountain side, and to judge of the direction from which the sound came, thus giving him an opportunity to escape approaching danger.

The loud voice, which in civilization is utterly lacking in musical tones, was probably developed to aid in meeting certain conditions in their new surroundings. Their search for food often led them so far from their companions that they would have been unable to return to them but for the fact that they possessed voices strong enough to carry a great distance when they wished either to locate their friends from whom they had become separated, or to send a challenge to their rivals across the intervening mountains.

In their mountain home, where pasturage was scarce, only a few, as a rule, traveled together. Even these few were frequently widely scattered in their search for food. If at such times a foe suddenly appeared, it was impossible for them to assemble and follow a leader; hence each must decide upon a course for himself. This



THE PERSIAN WILD ASS

naturally developed self-reliance and a disposition to act independently in the struggle for existence. When the donkey appears the most obstinate, it should be remembered that his obstinacy is possibly due to the fact that, because of his inherited qualities, he is seeking to assert his self-reliance and act as independently as he would have been able to do under the old conditions of freedom. His refusal to obey is his only means of reminding man of his inability to understand the new conditions.

That the donkey is smaller than the horse is probably due to the fact that all mountainous animals have a tendency to be small, owing either to the scarcity of food or to their surroundings. His legs are stout and sinewy, and his hoofs are more pointed than those of the horse. This enables him, when he pleases, to climb as well as a goat, and his nerves are so steady that he never loses his head even when following the most dangerous trail.

Another species of wild ass is found in the salt marshes of one of the provinces of India. In an attempt to describe the home of this ass some writer has fitly said, "His house the wilderness, the barren lands his dwelling," for the moment danger is scented he flees to the marshy lands that are impenetrable to man, but which offer him both secure shelter and abundant food. This species is remarkable for its fleetness, in which respect it is said to equal the gazelle. They are not only fleet of foot but are counted among the most graceful animals of creation. In color they are creamy white, shading to pure white on the back. The head and muzzle are finely shaped, and the ears are neither long nor pointed. These animals are accustomed to congregate in herds of from sixty to seventy, each herd being led by a male. Spring is the only time of year when it is possible to capture these animals. It is said that at this time the mother, her young being a few months old, leaves the herd and seeks the border of the wilderness for the

purpose of securing better food and pasturage. When alarmed, the mother hides her little one and flees, hoping by this device to trick the hunter into following her, knowing that she can easily outrun him, then turn on her own tracks and rescue her baby.



THE DONKEY, OR DOMESTIC ASS

But experience has taught the sportsman the true meaning of the mother's flight, and so, instead of following her, he seeks the young ass near the spot where the mother first appeared, sure of being rewarded if he waits quietly and patiently. In a short time the young ass, hearing no sound and thinking all is safe, ventures from its hiding place in search of food and is easily captured.

THE ZEBRA

The first that was known of the zebra was about three hundred years ago, when a missionary in Africa sent home a description of a strange animal that the natives had found. The description was accompanied by a sketch that pictured him with stripes as brilliant in color as Joseph's coat, and a head so out of proportion as to be impossible. The first true picture of a living zebra was made in the year 1760, and it was from this that the world received its first accurate knowledge of this remarkable animal.

The singular markings and the natural beauty of color make the zebra the most striking animal among mammals. So far as is known, they are peculiar to South Africa, where three distinct species have been found. The true or mountain zebra is the smallest of the three species, and has longer ears, a shorter mane, and less hair on his tail than the others. When these animals are feeding among the crags and precipices of the high mountains, they post a sentinel to guard the herd, and, when frightened by a warning note, gallop over the rocks and crags as sure-footed and swift as a chamois.

Concerning the beauty of the zebra there is no question, but his fitness for work has yet to be proved. The Boers succeeded in capturing and breaking a few of Burchell's zebras, but they never succeeded in raising any for domestic service.

There are to-day certain parts of Africa where either the climate or the "fly" makes it impossible for the ox or horse to live, and in these regions man needs the aid of a hardy domestic animal. Since the discovery of great herds of zebras on the plains and plateaus about the great lakes of Africa, the English people in Africa have thought it might be possible to capture and place them in kraals, where they could be tamed and raised for domestic

purposes. In time this will probably be accomplished, for the zebra is not only fitted to live on the high plains and dry mountains, but can also adapt himself to living out-of-doors all winter. He lives on a very scanty supply of food, and seems to thrive on the meager



THE ZEBRA

plants of the wilderness, but he is a thirsty animal and needs to drink twice a day. A marked peculiarity of the zebra is the fact that the herd never travels in a compact body, but goes Indian fashion, single file, the male always leading. So rapid is their flight that they easily outrun the swiftest horse, thus rendering useless all attempts of the hunter to follow.

Summary. 1. Of what practical value is the living horse to man? What especially fits him for work? 2. In what respects does the wild horse differ from the domestic animal? 3. How does the practical value of the donkey compare with that of the horse? 4. Where can he be of greater value to man than the horse? Why? 5. Why is the zebra of no practical value to man? 6. In what parts of Africa would his strength make him of special value if he could be domesticated? 7. Turn to the table of classification and find to what order, subclass, class, and subkingdom the donkey and zebra belong, stating the reason for each fact as you give it. 8. What characteristic shows that these animals belong to the same order as the horse?

CHAPTER II

HERBIVOROUS ANIMALS (CONTINUED)

SPECIAL STUDY OF THE COW

Examine the outline of classification (p. 189) and determine to which subkingdom, class, subclass, and order the cow belongs. From your study of this outline see if you can give the four important characteristics of the cow.

Under a picture of the cow make a record of these distinguishing characteristics.

Observation work. Examine the sketch of the cow's mouth, compare it with that of the horse, and determine the number and arrangement of the cow's teeth. In what respects are the cow's back teeth like those of the horse? the lower front teeth? What takes the place of the upper front teeth? Does the cow bite off the grass? For what are the front teeth adapted? the back



THE COW'S SKULL

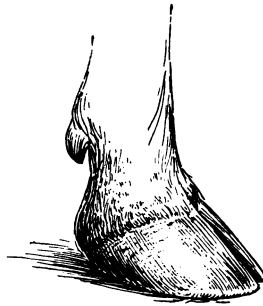
teeth? Compare the length of the cow's tongue with that of the horse's tongue, and describe the way the cow uses her tongue in gathering food. What other peculiar habit of eating has the cow?

Make a record of the facts relating to the adaptation of the cow's teeth and tongue to her habits of eating.

Examine the picture of the skeleton of the cow and find the foot. Determine how many toes the cow has, and on which part of her foot she walks. Notice the position of the hoof with reference to the toe, and see if it corresponds with that of the horse.



THE COW'S TOES



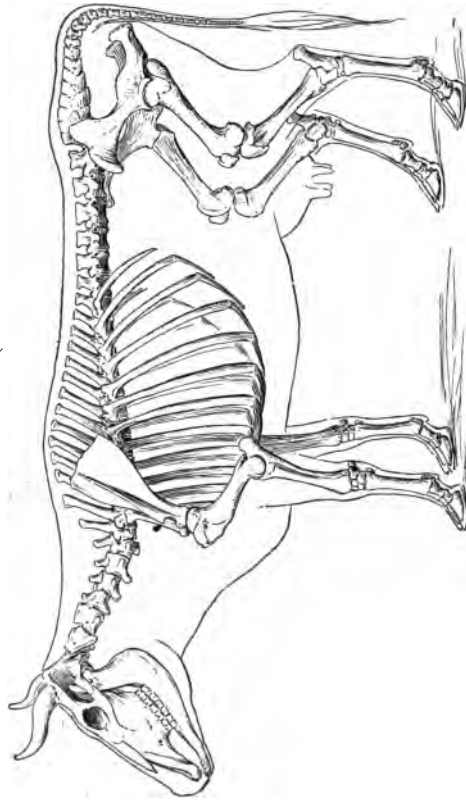
THE COW'S HOOF

Under a sketch of the cow's foot make a record of the facts that show the adaptation of the cow's feet to her habits of life.

Questions for thought.

1. Why is the cow said to have a cleft or divided hoof? 2. What is the natural action of the toes when they are pressed upon the ground? 3. How does this action of the toes aid the cow when traveling over wet or soft ground? 4. Does the cow wear shoes? Why? 5. Why does the ox need them? 6. What is the shape of the shoe worn by the ox?

Your observations have probably led you to discover certain reasons why herbivorous animals are divided into different families, and to note the differences between those to which the cow and the horse belong. If so, then the following stories will help you to understand why the habits of animals are largely the result of their surroundings.



THE SKELETON OF THE COW

CATTLE

In this country the horse is considered our most valuable beast of burden on account of his speed, strength, and intelligence, and at one time the ox was counted as second in importance. Though his strength surpasses that of the horse, he is not so intelligent an animal and for this reason has never been able to do as much for man.



OXEN WEARING HEAD YOKE

"As strong as an ox" is an old saying that goes to show that in this one respect he has always been considered superior to other domestic animals. His great strength is inherited and may be traced to two causes. First, our domestic animals are descended from wild cattle which lived surrounded by carnivorous foes with which they battled daily, and only the strong survived. The other cause was probably the desperate struggles that were constantly

taking place between rival bulls which sought the position of leader of the herd. As they fought by thrusting and charging at one another with their horns, their success depended not alone on agility but on weight and strength. Victory was won when a bull succeeded in tossing his opponent, and since he often weighed a ton, the accomplishment of this feat required great strength of neck and head. It is largely to these struggles of his ancestors that the ox owes the strength that has made him of such service to man.



OXEN WEARING NECK YOKE

When we know where his great strength lies and how it was acquired, we appreciate the fitness of the yoke. Only as the ox can make use of the strength of his head and neck can he serve us to advantage. Of the two yokes devised by man (pp. 22 and 23) the one fitted to the head is best adapted for easy pulling, since the strength of the ox lies more in his head than in his neck.

No hard work has ever been required of the cow, and because we depend upon her for the supply of milk that forms such an

important part of our food, we have grown accustomed to thinking of her as having been created for no other purpose. If we consider how the wild cattle lived, we shall understand why it is that the cow is the only domestic animal that yields milk in any quantity. During the first few months of the calf's life it was not strong enough to follow its mother about in search of food. Anxious for the safety of her baby, the mother was accustomed to hide it in a thicket during her absence, and there it had to remain without nourishment until she returned. In order that the hunger of her little one might be satisfied after its long fast, the mother was provided with an udder fitted to retain the milk that slowly collected during the day. When man made the discovery that this calf's food was the best natural food that could be found, he wanted the milk for his own use, and this could only be accomplished by selfishly taking from the mother the nourishment belonging to her little one.

Living as the wild cattle did, in a country where they were surrounded by dangerous enemies, they had no time to feed leisurely or even to masticate their food while feeding. They were obliged to gather a supply of food as rapidly as possible, and to get it during the hours when their enemies were least abroad. Having secured the food that they needed, they retired to some safe hiding place and lay down to ruminate, or chew their food, at leisure.

The horse can travel rapidly over a smooth, hard surface, but he makes but little progress when he is passing over moist or swampy land, and this is due to the formation of his toe. As soon as his toe strikes a soft, yielding surface, the hollow around the frog within the hoof fills with air and acts like a sucker, tending to hold the foot to the ground. Cattle have no such difficulty, and in muddy or boggy land can easily outrun the horse, because they are

provided with two toes. These toes separate and, spreading out, cover a broader surface, thus preventing the foot from sinking into the soft soil.

It is well known that the ox, with all his strength, is unable to carry any great load on his back. This is due to the fact that he is not so strong in his feet as either the horse or the mule. If he should be forced to carry heavy loads, the pressure on the toes would be so increased as to spread them unnaturally and soon cause disease.

Have you ever noticed how low the cattle carry their heads? This is supposed to be another peculiarity inherited from their wild ancestors. Their grazing lands lay beneath the spreading branches of forest trees, and it was only by holding their heads low that they could see any distance through the branches. With danger threatening them on every side, they lived in fear of being taken by surprise, and thus the habit of holding their heads low in order to watch, grew upon them until it became one of the distinguishing characteristics which we find in domestic cattle.

Although the cow has neither speed nor strength to fit her for such work as is done by the horse, yet in other ways she does for man what no other domestic animal is able to do. She gives him milk, the most important natural food that is produced, and this provides him also with butter and cheese; her flesh is considered a more desirable meat than that of any other animal; her hide is made into leather; the fat, blood, and intestines are used in the preparation of certain manufactured articles; the bones are ground to a powder and form an important part of many fertilizers, and are also used in the manufacture of glue and gelatins; the horns are made into combs and buttons; the hair is used in making felt and plaster.

SHEEP

No animal domesticated by man is so timid and defenseless as the sheep. They are so dependent upon man for care that it is said that if they were left to run wild and care for themselves, they would wholly disappear from the face of the earth in five or six years. It can readily be seen that there are at least three reasons why they



A EWE AND HER LAMB

could not live without care. First, if left to run wild, they have no means of protecting themselves, for they are not brave, swift, or cunning, and become an easy prey for the smallest of their carnivorous foes. Second, the young lambs and

their mothers need special attention, and if this is not given, the little one usually dies. Third, among the species of sheep now living, scarcely any shed their wool naturally, as the horse sheds his thick, heavy hair, and unless relieved of the burden of this load of wool, the poor animals would weaken and die.

Like all the other domestic animals, the sheep of to-day are descendants of wild sheep, but while the ox or horse can care for himself if allowed to run wild, captivity has unfitted the sheep to return to the ways of wild life. When first discovered by man, their home was in the mountains, where they had been driven through fear of the fierce carnivorous animals of the lowlands. Living high up in the mountains, their covering of coarse hair was not warm enough to protect them from the cold. In time



A FLOCK OF SHEEP GRAZING

a thick covering developed beneath this long hair. When this hair was no longer needed, it disappeared, leaving the animal protected by a thick growth of wool. It was this accumulated growth of wool, or fleece, that first attracted man's attention to the sheep and led to their capture and domestication.



WALLACHIAN RAM

A long-haired sheep raised in Greece

There is one other way in which this wild life in the mountains developed the sheep and increased their usefulness to man. The structure of their feet shows how perfectly they were adapted for climbing crags and mountain slopes. As they wandered about in search of food or sought to escape from danger, they found frequent need of climbing steep slopes with great rapidity, and of

leaping from rock to rock. This exercise caused the muscles of the hind quarters to become stout and fleshy, and it is to this fact that man owes that choice portion of meat known as "leg of mutton."

When taken into captivity, sheep were so accustomed to a certain condition of surroundings that they could not adapt themselves to changes, and watchful care was needed to keep them alive. It is believed that their stupidity is due to their inability to take care of themselves, and is the direct result of this change in surroundings.

In the mountains the instinct of self-preservation caused them to live in flocks led and guarded by a male sheep. Wherever the leader went they all followed, since safety depended on their keeping together. This habit of following was practiced so long that it became a characteristic, and to this day they travel in flocks and follow the leading of the shepherd with unquestioning faith.

THE GOAT

The domestic goat is another descendant of mountain dwellers. These animals, living together in bands, are to be found on nearly all the mountains of southern Europe, northern Africa, and in the Rocky Mountains of North America. They feed on the scanty grass on the mountain slopes or on the buds of certain dwarf trees and shrubs. While the band is feeding, they usually post a sentinel, whose duty it is to sound an alarm if the approach of an enemy is detected. Sometimes it looks as if their system of relieving these guards had been most carefully planned, for observation has shown that each member of the band takes his turn as sentinel. First a kid takes his position on a commanding rock, where he stands for about ten minutes without moving, while the others are feeding below. At the end of that time he goes down and

another takes his place. After the kids have taken their watch, then the ewes follow ; next come the young rams, and last of all the oldest member of the band takes his turn. Their feet are small with pointed hoofs, which give them such sure-footedness that they can jump with perfect confidence from a height of



ROCKY MOUNTAIN GOAT

twenty or thirty feet to a rock that is only large enough to hold their four feet. Here they will remain balanced or, poising themselves, will spring to other projecting rocks near by.

These animals were first domesticated by the ancients for the milk they furnished and for their flesh. The common goat is extensively raised in many of the Mediterranean countries for its

milk and hair. The goats are sheared once a year in much the same way that our sheep are sheared. Certain wandering tribes in the East still use the skins for water bottles, while others make them into clothing.

The goats that are raised in Tibet and Kashmir are considered the most valuable. Their wool, which is extremely fine, soft, and fleecy, is covered with a long, fine, straight, and stiff outer hair. This wool is what makes it possible for the goat to endure the severe cold of the mountains of central Asia. The undergrowth of wool is used in the manufacture of the fine cashmere shawls of India. In order to shear the animal and keep the wool in the best possible condition the coat is removed every year by means of a comb of double teeth made expressly for the purpose.

The Angora goat ranks second in value on account of the fact that its fleece, which is composed of long, fine wool, preserves its luster after it has been dyed. This wool is used in the manufacture of mohair and plush. The Angora goats that have been introduced into this country were brought from Turkey, and are valued for the aid they give in clearing brush land. Their ability to do this results from the fact that they thrive on leaves, bark, small twigs, weeds, and other waste material which no other farm animal except the sheep would be likely to touch.

The skin of the goat is extensively used in the manufacture of kid for gloves, parchment, morocco, and other fine leathers.

THE BUFFALO

The first buffalo ever seen by any Europeans was the one that Cortés saw in the year 1521, when he visited the royal museum of Montezuma in the ancient city of Mexico. Of all living land animals native to North America the buffalo is the largest. The center of their life was the great expanse of treeless plains west

of the Mississippi River. It has been estimated that at one time there were as many as seventy-five millions of these animals living in the United States. They were not always to be found in the same place, for they were great wanderers, grazing in one place until the food supply was exhausted, then moving on to new feeding grounds. Sometimes at the approach of cold weather the herd would move southward from two to three hundred miles.

When the Kansas Pacific Railroad was first built, the engineers learned to stop their trains when they met a passing herd, for experience had taught them that unless they did so the train was in danger of being wrecked by the onward rush of the animals. When traveling together in great numbers, the buffaloes always followed a leader, but when they were once under way the leader lost all power of stopping or turning them aside, because those in front were being constantly crowded upon and pushed forward by those in the rear. When frightened, they would rush blindly forward, over, against, or through anything that happened to be in their way. If it chanced that a river crossed their route, those in front were crowded over the bank into the water and trampled upon until the dead piled up in such numbers as to form a bridge on which the others could cross. In this way thousands perished each year, being trampled to death in the mire or lost in the quicksand or drowned in the rivers.

The buffalo, in his search for places where the herbage was least covered with snow, marked out the best and easiest paths across the plains — a fact which the early settlers were quick to recognize and take advantage of. In his wild state the buffalo was a hardy animal, able to forage in deep snow for his food and to live in the open all winter. The qualities that made him an object to be feared were his fierce temper and a strength so great that no fence could be built strong enough to withstand the attacks of the bull.

The coat of the buffalo is in its best condition in December. They shed their hair in midsummer, at which time it is so loose that it falls off in great patches, giving them a very ragged appearance. While shedding their hair they like to rub against the rough



A BUFFALO SHEDDING HIS HAIR

bark of trees. The early settlers used frequently to find trees against which the buffaloes had rubbed their shoulders and sides until the bark was as smooth as a polished surface. It is said that when the telegraph poles were first put up across the plains, the buffaloes

made such constant use of them as scratching posts that they did great damage to the wires. In order to drive the buffaloes away, spikes were driven into the posts, but these they seemed to consider a great improvement, and used the posts more frequently than before. When troubled by flies or other insects, they were accustomed to make what is known as a wallow; that is, one buffalo would find a damp spot in the soil and roll in it, then the others would take turns rolling in it, each one making it larger, until it was sometimes twenty feet in diameter. This wallowing not only killed the insects but aided in removing the loose hair.

Less than fifty years ago it was possible to travel for a week at a time through the northern part of Montana and not lose sight of the buffaloes; frequently they were to be seen in herds, but more often they were scattered about, feeding or lying down. In the year 1905 there were in the United States less than one hundred pure-blooded animals. Their rapid disappearance is due to the fact that their number and size made them attractive objects to the sportsman, who hunted them for the mere fun of killing. The only parts of the animal these hunters cared to save were the skin, the head, and the tongue (which they considered a choice bit of meat). The skin, or robe, as it was called, was worth from twenty-five to forty dollars, while the head, when mounted, was considered almost as valuable.

Fortunately, the real value of these animals was recognized in time to save them from being entirely destroyed. At the present time there are but two herds of wild buffaloes in existence. One of these, numbering about 300, lives in Athabasca and in the region of Great Slave Lake; the other, numbering not more than 20, is running wild in Yellowstone Park. In other parts of the United States there are nine herds in captivity; the largest of these, numbering 225, is a private herd in Montana. There are



BUFFALO HERD

two small herds in New Hampshire, one of 32 in Lenox, Massachusetts, one of 55 in Oklahoma, and another in South Dakota.

As long as the buffalo existed in such great numbers the settlement of the Western plains was an impossibility, since the wandering herds not only ate up the grass that was needed for cattle, but by their number and strength made the raising of crops an impossibility. If the country was to be settled, their destruction seemed a necessity, yet it is to be hoped that the herds now in confinement will increase in numbers sufficiently to prevent the utter destruction of the species.

THE GIRAFFE

Of all the herbivorous animals the giraffe is perhaps the most peculiar in appearance, on account of the great length of his neck. He makes his home in the south-central part of Africa, and has never been found in any other country. In the Bronx Zoo in New York City are two fine specimens of the giraffe, and it is said that they are the only animals there which make no noise, for during all the time they have been in the Zoo they have never uttered a sound.

They are extremely fond of the leaves of the giraffe acacia, and sometimes as many as fifteen have been seen eating around one tree. Their long necks help them to reach the topmost branches, and their flexible tongues aid them in gathering the tender buds and leaves. It would seem that with such long necks it might be an easy matter for them to feed from the ground, but the truth is that they can do this with great difficulty. Their forelegs being so much longer than their hind legs, they are forced to spread them far apart in order to reach the ground to feed like other herbivorous animals. They require very little water. It is well known that in Africa, during the spring and winter seasons, they live for



NUBIAN GIRAFFE

months without drinking. This is shown by the fact that during this time they usually go to the dry regions, where there is no water supply.

Covered with a hide that is from an inch to an inch and a quarter in thickness, they are able, owing to their great weight, to force their way uninjured through such thick jungles and dense growths that neither man nor horse can follow them without being torn to pieces. Their eyesight is wonderfully keen, so that with their heads held high they can command a wide view of the horizon and thus guard against being taken by surprise by their enemies. This is quite necessary if they would escape harm, since their only means of defense is to kick with their forefeet. Their size and the length of their stride give them the appearance of moving slowly, whereas in reality they travel so rapidly that the hunter finds difficulty in following them. On the head of the giraffe are bony growths covered with hair, which are called horns, but which are neither horns nor antlers in the true sense of these words. When the animal is young, these growths can be easily removed, but by the time the giraffe has reached his full growth they have become firmly attached to the skull.

At the present time these animals are hunted chiefly for their skins, which are beautifully marked.

THE REINDEER

In the Arctic regions of Sweden, Russia, and Siberia, where the lack of soil and the severity of the climate prevent the growth of trees and grass, the rocks are thickly covered with moss. Here, where no other herbivorous animal can live, on account of the lack of food, the reindeer are found in great numbers. They live and thrive upon the moss which is commonly known as reindeer moss. Of the domestic animals the reindeer is the only one that costs us



THE REINDEER

nothing to keep. It is a well-known fact that they refuse to touch moss that has been gathered for them, and are satisfied only when permitted to find their own food. Even when deep snows cover the ground, they are perfectly able to care for themselves, and will dig through two or three feet of snow in their efforts to reach the moss which their keen sense of smell enables them to detect. They dig first with one foot, then with the other, their broad, sharp hoofs being specially fitted for this digging. One branch of their antlers is usually broader than the others, and this they often use to sweep away the snow as they dig. It is only when they find the snow covered with a thick crust of ice that they have any difficulty in reaching their food.

Their ability to care for themselves is what has made them valuable to the people of the far North. To them the reindeer stands for all the comforts of life. Every part of the animal, living or dead, is used. The flesh, milk, blood, entrails, and even the marrow are all eaten. The skin furnishes material for the warmest kind of clothing, while the sinews are twisted into threads and used for sewing the skins. The antlers and bones are made into many kinds of household utensils, and also into ornaments. Those parts that cannot be used in any other way are made into glue, or boiled into soup and fed to the dogs.

As a means of transportation in the Arctic region the reindeer has no equal, and he can be used either for drawing or carrying loads. He can endure any amount of cold and is a rapid traveler, usually going at the rate of five miles an hour, though his speed depends greatly upon the country over which he travels. Many instances have been reported of his having traveled between eighty and one hundred miles a day. His two long toes are protected by such broad hoofs that they give his feet the appearance of being too large for his body, but when traveling over soft, damp snow,

or soil that is miry, they spread out so as to cover a surface broad enough to prevent him from sinking. When the deer are moving rapidly, their hoofs make a strange metallic, clicking sound. This is caused by the closing of the toes as they are lifted from the ground.

This is the only kind of deer in which the female has antlers. These are shed every year early in the spring. By the first of June the new ones have grown from one to two feet in length. The new horns retain their first velvety covering until they are fully grown and hard, and then, being no longer needed for protection, this dries and peels off. While the horns are in the velvet they are very tender, and it is during this period that the reindeer devotes much time to training them to grow forward. This they do either by throwing their heads back on their shoulders, or by stroking them with their hind feet. They will frequently start new prongs by kicking the tender shaft until it bleeds, which will cause a bud to start from the wounded place. Between the toes of their hind feet is an oil duct, and when they shed their horns they keep the place well oiled by rubbing the hind foot over it.

So far as is known, wild reindeer have never been found in the Arctic regions of North America, but they have been most successfully introduced in different parts of Alaska since the year 1892. Some time before this the discovery was made that reindeer moss grew in large quantities in this country. This led to the belief that if the reindeer could be made to live there, the wretched condition of the Eskimos could be improved, and they could be made as comfortable and prosperous as their Siberian neighbors across the sea. The first herd of sixteen reindeer was bought in Siberia and taken to Alaska. There are now more than eight thousand reindeer in Alaska. Of these the government owns four thousand, and the remainder are owned by the

native Eskimos, who have been taught how to herd and train them for driving. A similar experiment is being tried in Labrador by Dr. Wilfred T. Grenfell, and his work is meeting with great success.

THE CAMEL

It would be as difficult for one to trace the story of the domestication of the camel as to trace the origin of the horse. Pictures of camels were found on ancient Assyrian monuments, which represented them as working for man. In the book of Genesis we read that Abraham numbered camels among the valuable presents given him by Pharaoh at the close of his first visit to Egypt. While history gives but little information, it tells us enough to show that man's use of the camel dates back several thousand years.

The true camel is the stronger, more heavily built animal, having two humps. The one-humped species is commonly known as a dromedary. The camel and dromedary are both animals of the desert regions of Asia and Africa. In order to understand their adaptation to such surroundings it is necessary to learn something of their peculiar habits. These animals like to gather their own food, and, though they much prefer thistles and tender leaves, they will eat any vegetation they find growing along their route through the desert. Since they must gather most of their food as they move, they are provided with necks long enough to let them reach the leaves above their heads, or the plants growing at their feet. The upper lip, being divided, permits them to nip off the tender shoots and turn them into their mouths with great rapidity. If there is an abundance of food, they will eat enough in two hours to last them twenty-four. This shows that, like cattle, their habit is to lay in a large supply of food and ruminate at leisure. When on the march

their daily portion of food consists of four pounds of dough-balls, a mixture of ground wheat and horse beans or barley. Should this supply fail, the camel is able to live for some time without food,



THE BACTRIAN CAMEL

as the fatty tissues forming the hump and covering the limbs are absorbed by the blood and supply him with nourishment.

A drink of water once in three days is all that is allowed them while on the march. When they do drink it is estimated that they

will swallow thirty quarts of water at one time. Their stomach differs from that of other ruminating animals in that one of the four divisions consists of layers of cells so formed as to be able to receive and retain water. Whether the water flows into these cells when the camel drinks, and is there held in reserve for future use,



LLAMA

An animal related to the camel

or whether it is a liquid that the stomach secretes, is not definitely known. Examination has shown that this division of the stomach frequently contains as much as ten quarts of water.

Though the sandy floor of the desert is yielding to the foot, and is very hot during the day, the foot of the camel is well fitted to

meet these conditions. The two toes are united almost to their points by a horny sole, while their tips are protected by small hoofs. Beneath the toes is a soft cushion upon which the weight of



ALPACA

An animal related to the camel

the foot rests, and this, spreading as the toes separate in walking, prevents the foot from sinking into the sand.

In the desert regions of both Asia and Africa camels are used as beasts of burden, and form the principal means of carrying goods

to inland places. It has been estimated that in one section of Asiatic Turkey, of which Bagdad is the chief city, there are nearly ninety thousand camels which are used as beasts of burden. When several caravans chance to meet at Bagdad, as they frequently do, it is no uncommon sight to see two or three thousand camels feeding outside the walls of the city.

Understanding the fitness of camels for desert life, the United States government thought it might be possible to introduce them into this country and use them as a means of transportation in the desert region between Texas and California. In the year 1857 the government decided to establish an experiment station in the southwestern part of Texas. For this purpose forty camels were brought from Egypt and Asia Minor and sent to the post at Camp Verde. They were kept there eleven years, but the experiment was not successful and no practical use was ever made of them.

THE YAK

While the reindeer, Arctic fox, and Eskimo dog are able to endure the severe cold of the polar regions, the yak is the only animal that can not only endure the bitterest cold and most violent snowstorms and hailstorms, but can thrive in the rare atmosphere of the high plateau and mountain regions of Asia.

The yak is domesticated and used as a beast of burden in the plateau of Tibet and in other parts of central Asia. He is about as large as the buffalo, and can be broken to the saddle and trained to carry loads like a pack horse. His hair is coal-black except on the shoulders, where in certain lights it looks dark brown. The only way of guiding him is by means of a cord drawn through the cartilage of his nose, but to this he pays very little attention, and goes his own way in spite of all the driver may do. When on the march he holds his nose close to the ground and breathes so loudly

that it sounds like the buzz of a distant sawmill. He feeds chiefly on the grass, moss, and lichens that grow only in regions of high altitude. His tongue is very rough, being covered with horny barbs (called papillæ) that point backwards. In cropping food he uses his tongue more than he does his teeth or his horny upper jaw.

The wild yak is hunted for his flesh and skin. The latter is considered valuable on account of its toughness. The hunting month is October, because at this time the yak leaves the higher feeding grounds and comes down the mountains in search of food.

Summary. 1. Name three distinguishing characteristics that are common to cattle, sheep, goats, buffaloes, camels, reindeer, giraffes, and yaks. 2. Which one of all these animals is of the greatest use to the greatest number of people? Why? 3. Which one is second in value? Why? 4. Which one is fitted to live in very cold regions? 5. What especially fits him for this? 6. Which animal lives in high mountainous regions? 7. Why can he live there? 8. State three facts showing how the camel is adapted for traveling in the desert. 9. Which of these animals furnish man with flesh for food? with wool or hair for clothing? with skins for clothing? 10. Name the two animals that have never been domesticated. 11. Are they of any special value to man? Why? 12. Why can cattle not live in very cold countries or in desert regions? 13. Why could the reindeer not live in the United States?

CHAPTER III

CARNIVOROUS ANIMALS

SPECIAL STUDY OF THE CAT

Examine the outline of classification (p. 189) and determine to which subkingdom, class, subclass, and order the cat belongs. From your study of the outline give the four important distinguishing characteristics of the cat.

Under a picture of the cat make a record of her distinguishing characteristics.

Observation work. Examine the mouth of the cat and discover how many kinds of teeth she has. Give the number and position of each kind. Compare them with your own and note the difference. Watch the cat eat and note how she moves her jaw. In how many ways do you move your jaw when chewing food? Can the cat chew? Why? Think of the adaptation of the back teeth for cutting flesh, the special use of the long, sharp canine teeth and the small, sharp front teeth.



CAT'S MOUTH

Watch the cat lap milk, to see how she uses her tongue. Examine your own tongue and notice the papillæ. How do the papillæ on the cat's tongue differ from those on yours? How does this aid the cat in drinking? in cleansing her fur?



MIDDAY

Effect of light on cat's eyes

has on her eyes. Place her in the dark and note the change in the pupils. Think what causes this change. Of what value is this to the cat? When does she hunt for prey? How is she fitted to do this?

Make a sketch of the cat's eye in your notebook and record the facts you have discovered, showing the adaptation of the cat's eye to her habit of catching prey.

Make a summary of these observations and record the facts that show the adaptation of the cat's teeth and tongue to her habits of eating and cleansing herself.

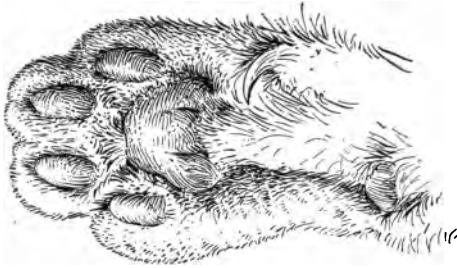
Study your own eyes, noting the general shape, the color of the different parts, the shape and relative position of each part. Make a sketch to illustrate these features. Observe the cat's eye; make a sketch of it and compare this with a sketch of your own eye. What differences do you notice? Place the cat in the sunlight and notice the effect the light



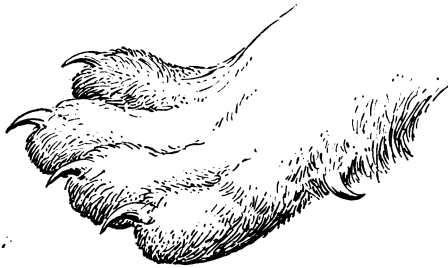
TWILIGHT

Effect of light on cat's eyes

Compare the cat's fore and hind legs, to note the difference in length and the position in which they are usually held. Of what value to the cat are these long hind legs? Examine her feet and note the number of toes. On what part of her feet does she walk?



CAT'S PAW WITH THE CLAWS WITHDRAWN



CAT'S PAW, SHOWING CLAWS

What do you notice on the bottom of her feet? Of what value are these when she walks? when she springs? Place your finger under the toes and press lightly. What do you notice? What kind of claws are they? For what are they used? How must they be kept? How are they protected? What are such kinds of claws called? How does the cat use them in catching prey? in climbing?

Make a record of the facts that show how the cat's feet are adapted to her habit of catching prey. Make a list of all the wild animals that are like the cat. Illustrate this list with pictures as far as possible.

Questions for thought. 1. Of what value is the cat to man? 2. Think of all the different ways the cat is fitted to hunt for prey. 3. In what ways is she fitted to be a pet? 4. Are there any other domestic animals like the cat? 5. With which of the different species of cats are you familiar?

Familiar though you are with the cat, there are certain facts relating to her early life and habits with which you may not be acquainted. A knowledge of the conditions under which she once lived may help you to appreciate some of her marked peculiarities. The other members of this family are animals greatly feared by man, and you will enjoy the stories that show why they are so dangerous to both man and beast.

THE CAT

The domestic animals most closely associated with man in his home are the dog and cat. Nothing is known about the cat's introduction into domestic life, and if we study her history we find that she has had a most varied experience. It is a well-established fact that the ancient Egyptians considered the cat a most valuable animal — so valuable, in fact, as to be looked upon as sacred. At the



YOUNG WHITE CAT

time when Egypt ranked first among the civilized nations of the world, a city called Bubastis was built near the Nile and dedicated to cats. In this city the cat was worshiped, and whoever killed one was most severely punished, death being the penalty in some instances. These cats were kept in temples and were most tenderly cared for as long as they lived. When they died, their bodies were mummified and placed in cases, which were frequently carved to represent the living cat. One can easily prove that this golden

age of cats really existed, for at the present time the mummified cats may be seen in the Boston Museum of Fine Arts, in the British Museum in London, and in other large museums. A careful examination of these mummies shows that the cats' bodies were embalmed and wrapped in linen as fine in texture as that used for the bodies of kings.

After the invasion of Egypt by the Greeks and Romans the cat lost her high position. These invaders discovered the cat's fond-



ENJOYING THE SUN

ness for hunting, and carried her home with them, hoping that she would drive the rats and mice away from their homes and granaries. From these southern countries the cat was carried to other parts of Europe and even into Asia. She was not taken across the water into the British Isles until

the year 800 A.D. Of the time of her introduction into America we have no knowledge, since there are no records to tell who among the early settlers was responsible for bringing her from the Old World. Everywhere she was valued, either as a household pet or for her hunting instincts. In Holland, cats are raised for their fur, while in China they are raised for food.

A thoughtful study of the cat will show certain traits of character that must have been inherited from wild ancestors. In spite of the fact that the cat has lived with man a longer time than we have



WHITE PERSIAN CAT



BLUE PERSIAN CAT

any certain knowledge of, she is in reality the least tame of any of our domestic animals. Watch her ways of hunting and you will see that these are instinctive with her instead of being the result of any training she has received from man. She shows that from



THE CAT CLIMBING

necessity she has always been in the habit of hunting by herself. Living upon animals smaller than herself, she needed to approach them in a more stealthy manner than would have been possible had she hunted in company with other cats. She seems to be more attached to places than to people. Is this not due to her having inherited the instinct of selecting some fixed spot as her home in order to devote her attention to the game in that locality? Then again, if you watch the cat eat, you will observe that she crouches down in a comfortable position in order to eat at her leisure, and that she

selects her food with great care and deliberation. This shows that her ancestors were in all probability accustomed to taking their meals in undisturbed solitude.

Of the different species of cats that exist, the Manx cat is perhaps one of the choicest. She differs from other cats in having no tail, a very small head, long, powerful hind legs, which cause her

to lope like a hare or rabbit, and a coat of true fur instead of hair. The Siamese cat is another remarkably handsome fur-bearing animal, having a cream-colored body, with nose, ears, paws, and tail of a deep chocolate color. Of the long-haired cats the Angora, which comes from the high, cold table-land of central Asia, is considered the handsomest. Of these the pure black ones are the rarest and most valuable. Tortoiseshell cats are extremely beautiful, but a perfect specimen is hard to find, for the fur of the real tortoiseshell is yellow, red, and black.

In England there are about two thousand cats that belong to the government. They are kept in public buildings to protect the mail bags, grain bags, army stores, and other goods belonging to the different departments. They have proved so valuable in ridding the buildings of rats and mice that they are on the pay roll of the government. Twenty-five cents a week is allowed for the food and care of each cat, and if they are sick, a special doctor is hired by the government to take care of them.



SIAMESE CAT

If we consider the question of the usefulness of the cat as compared with that of other domestic animals, it is doubtful whether her good qualities as a household pet will prove great enough to atone for the harm she does as a destroyer of bird life.

THE LION

Of the wild animals belonging to this order the lion is the most majestic, and rightly deserves the title "king of beasts" so frequently applied to him. No other animal, however, is as dangerous and cruel, unless, perhaps, it is the leopard.

In Africa when the lions hunt, which is always at night, they frequently travel in troops consisting of one male lion, several lionesses, and their half-grown cubs. In the early part of the night a moan or a long, deep sigh is a sure indication that the lion is hungry. If, toward morning, he has succeeded in securing a goodly supply of food, he is apt to proclaim the fact by a loud, fierce roar. After he has eaten and had a good drink, he will, if alone, often throw himself down to sleep in the first shady spot to which he comes, for he has no fear of other wild animals. Sometimes the members of the band hunt in a long, extended line. When they have finished their hunt, they gather at some point which they have previously selected as their place of rest for the day. One or two of the band will lie down with their noses toward the back trail, apparently acting as guards. If they sound the note of alarm, the others will instantly disappear into the grass. It is curious to see how completely their tawny color hides them when they crouch flat against the yellow earth, though the grass may be less than two feet high.

When a lion has succeeded in killing his prey, and wishes to remove the skin, he steps back, takes a short run, and, putting his claws well into it, tears off great strips of the hide. The lion's usual

habit of eating his prey is to begin at the tail and eat toward the head. A man-eating lion will first lick off the skin, so as to get at the blood before he touches the flesh, and in the accomplishment of this his rough tongue serves him to good purpose. Most hunters consider the lion the most dangerous foe to be met among wild



AFRICAN LION

animals, for the lion has proved to his own satisfaction that he has nothing to fear from other animals, and until recently he has so seldom been hunted with a rifle that he has not yet learned to fear man. Occasionally he may slink off and not offer to fight, but if he is in the mood, or if he has been wounded, nothing but his death or the hunter's will satisfy him. When once he is fully roused, he

shows great daring and courage. The lioness alone with her cub is considered a much more dangerous foe than the male lion. She shows a great fondness for her young, and is known to keep her cubs with her until they are about two years old or are full grown. The little ones are two months old before they are able to walk. The fact that many male lions, when shot, are found to have no mane is because the mane does not develop until the animal is about three years old. The natives say that there are more female than male cubs, and in order to account for this they assert that the old male is so jealous of the young male that he kills all those he can find.

If a lion once gets a taste of human flesh, no other kind of food will satisfy him, and he becomes the most dangerous foe that man can have among animals. It is feared that as the game decreases in Africa the lion will become more and more destructive to domestic animals and human life.

In the year 1898 Colonel Peterson was sent by the English government to build a strip of railroad at a place called Tsavo, one hundred and thirty miles from Mombasa on the eastern coast of Africa. The presence of two man-eating lions soon made the camp a most undesirable place in which to live. The lions stalked their prey so stealthily that they were able to creep into the camp, seize their victim while he slept, and get away before his screams awakened his comrades. Camp fires were of no use as a means of protection, for these animals became so bold that they would spring into the midst of a group of men, secure the one they seemed to have selected before making the attack, and be off before any one sufficiently recovered from the fright to sound the alarm. After the lions had killed twenty-eight Indian coolies and a score of African natives, the workmen became so frightened that they refused to remain unless they were provided with lion-proof sleeping

quarters. For this reason the work on the railroad was stopped for three weeks, until Colonel Peterson had succeeded in killing the lions.

Not every man who has gone to Africa to hunt for big game has had the experience of seeing or killing a man-eating lion, for he is an animal that even the bravest hunter prefers not to meet. For this reason we are not surprised to learn that, so far as is known, but one hunter has ever written of finding the den of a man-eater. This he described as a cave that seemed to extend some distance under the rocks. Around the mouth and inside the cave were human bones, among which several copper bangles were found, proving beyond doubt that the cave was the home of a man-eating lion. Whether the writer found the cave by accident or as the result of deliberate search he does not say.

The lion is quite a different foe when pursued by a mounted hunter. When the hunter is on foot, the lion seems to realize instinctively that he can escape his pursuer at any time, but if the hunter is mounted on a fast horse, the lion soon finds that his pursuer can keep pace with him. He resents this and shows his determination to fight. If wounded, he will stop, turn around toward his foe, wait long enough to get his wind if he has been running, then crouch for the final spring. The lioness seems able to crouch lower than the lion, and makes the final onward rush more quickly, so that a charging lioness is a most difficult object to shoot. The last rush and spring of a few yards is said to be the fastest thing in the world, and neither man nor animal can escape it. The injuries received by a hunter when struck by a lion's paw are sure to result in death if medical assistance is not close at hand, because the claws are filled with an accumulation of dirt and blood, which acts like a poison if it enters the wound. In this way the lion is responsible for many deaths, since in nearly every lion hunt

one or more men receive wounds that result in death from blood poison because of neglect or inability to get medical assistance.

Africa is so rapidly becoming civilized that in time the lion will be exterminated or driven out. The safety of life and property is considered of greater importance than the preservation of the king of beasts.

THE TIGER

It was during the time of Alexander the Great that the ancients first learned that such animals as the tiger and elephant existed. In Alexander's conquest of the countries of Asia it was necessary for him to lead his armies through regions inhabited by these animals, and it is probable that the information he gained regarding them was the result of observations made while hunting them for amusement. To-day the tiger is found only in Asia, where he makes his home in the hilly parts of the country that have not been cultivated, or in parts where the forests have not been cleared away on account of the swampy nature of the soil.

The Royal Bengal tiger is a native of India, and is sometimes found as far north as the high regions of the Himalaya Mountains. He is frequently spoken of as the "king of cats." It is from this title that he probably gained the name "Royal," while "Bengal" is derived from the fact that the beauty and ferocity of the tiger is most developed in Bengal, a province in the northeastern part of India. The muscles of the Royal Bengal tiger are so well developed, especially about the chin, chest, and forelegs, that he is able to crush the skull of his prey with a single blow. His canine teeth are unusually large and strong. His retractile claws are very sharp, and he keeps them so by scratching them on the rough bark of trees. Frequently long vertical marks are found, eight and ten feet from the ground, showing where a tiger has either cleaned or

sharpened his claws. His pads, which are large and soft, have made him noted for his lightness of foot. They are of great assistance in making those long bounds which are one of the marked characteristics of the tiger. His food consists principally of deer, cattle, and wild hog. When hunting he advances in a stealthy manner until within a short springing distance of his prey ; then



BENGAL TIGER

with a quick rush and a loud roar he springs upon it, dashes it to the ground with his powerful paw, and, seizing it with his terrible fangs, holds it down until it is nearly or quite dead, and then drags it away to be eaten at leisure.

The man-eating tiger has frequently been described as one that was forced to eat human flesh when old age or other infirmities had rendered him unfit to hunt other game. That this is not true

is shown by the fact that tigers have been known to kill one or two men and then stop the practice. Moreover, the man-eating tiger is not necessarily old, but may be of any age. One thing that seems necessary for the development of the man-eating tiger is that he shall become familiar with the ways of man, for until he does, the strangeness and mystery surrounding beings that are unlike any others he meets makes him afraid to approach them. There are some tigers so shy and ill-natured that they prefer to dwell alone in forest lands or mountain regions. These never see man and so know nothing of his ways. Then there are others that prey upon cattle as they are being driven to and from villages in search of pasturage. Sometimes when a dry season makes it necessary to drive the cattle to more distant feeding grounds, the tigers will follow the herd in order to secure food. In such ways they gradually become accustomed to man and cease to fear him. It is nearly always from those that have ceased to fear man that the man-eating tiger is developed.

It is perhaps difficult to realize that the lion and tiger are of nearly the same size, for the shaggy mane of the lion surrounds a face in which every feature seems to express size and strength, while his roar proclaims his might, majesty, and power. Careful measurements, however, show that these two animals are quite evenly matched as to size, their average length being about eight feet from the tip of the nose to the tip of the tail, and their height a little over three feet at the shoulder.

It is believed that because the tiger is a better hider and a more skillful hunter than the lion, he will continue to enjoy life in the wild regions of India long after the lion has been exterminated in Africa. Owing to the fact that he has proved so destructive to domestic animals and to human life, his disappearance will be a matter of regret only to those who hunt him for sport.

THE LEOPARD

While the lion kills only when he is in need of food, the leopard frequently kills simply for pleasure. He has been known to enter a sheepfold where there were thirty sheep, and kill every one of the flock without eating a mouthful, just to gratify his fondness for destroying life. This is why he is so feared by the natives.



THE JAGUAR

A South American animal closely resembling the leopard

In proportion to the size of his body his limbs are much longer than those of the cat, but his claws are only partly retractile. He spends much of his leisure time sharpening them on rocks or the bark of trees. When trappers are searching for leopards, they look for places where the animals have recently sharpened their claws, and there they stretch the strong nets or rawhide nooses used in capturing them.

Leopards usually prefer to hunt in pairs or families and are seldom found alone. They differ from other members of the cat family in the manner in which they capture their prey. Instead of springing upon it as do the cat, lion, and tiger, the leopard chases it like a dog and, when he succeeds in overtaking it, grasps it by the throat, while going at full speed, and keeps his hold until he succeeds in bringing it to the ground.

The three animals, the lion, tiger, and leopard, are such dangerous foes to man and the domestic animals that their destruction is a thing to be desired rather than regretted.

Summary. 1. What common characteristics have all the members of the cat family? 2. What two characteristics distinguish this family from all others? 3. Is the cat of any practical value to man? Why? 4. Why has no attempt ever been made to domesticate the lion, tiger, or leopard?

CHAPTER IV

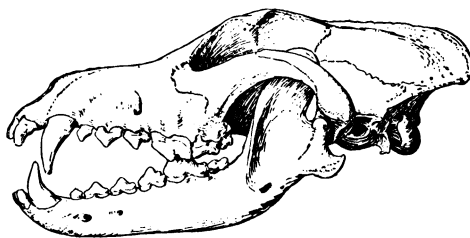
CARNIVOROUS ANIMALS (CONTINUED)

SPECIAL STUDY OF THE DOG

Examine the outline of classification (p. 189) and determine to which subkingdom, class, subclass, and order the dog belongs. See if, from a careful study of the outline, you can determine the four most important characteristics of the dog.

Under a picture of the dog make a record of his distinguishing characteristics.

Observation work. Examine the teeth of the dog and compare them with those of the cat, to note their similarity in



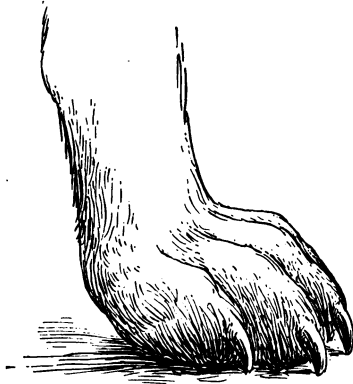
SKULL OF DOG

kind and arrangement, their difference in size and number. Compare the shape of the dog's head with that of the cat, to see if you can discover any reason for this difference in their teeth. For what are the different kinds of teeth adapted? Watch the dog eat and drink. Does he chew his food? Infer the reason for this. Notice how he uses his tongue when he drinks. See if it is as rough as the cat's. Does he need as rough a tongue?

From these observations make a record of the facts that show the adaptation of the dog's teeth and tongue to his habit of eating.

Compare the feet of the dog and the cat, to note the number of toes, the pads, and the nails. In what respects do the pads on the dog's feet differ from those on the cat's? Why does he need

harder pads? How do the nails differ? Does he need retractile claws? For what purpose does he use his claws?



DOG'S FOOT, SHOWING CLAWS

Make a summary of the facts showing how the dog's feet are adapted for running and digging. Make a list of the different kinds of dogs you have seen or heard about. Collect pictures of these and mount them in your notebook.

Add a list of the wild animals that are like the dog, and illustrate with pictures that can be used in connection with written descriptions.

Geographical distribution of the dog. Do you know of any dog that is especially fitted to live in cold regions? How is he adapted for such a life?

What dogs are adapted for living in high altitudes? Are dogs found in tropical regions? Is there any place where man can live that



DOG'S FOOT, SHOWING CUSHIONS

the dog is not found? Why has man carried the dog with him wherever he has gone to live? From the facts just determined state briefly the geographical distribution of the dog.

Questions for thought. 1. Of what special use to man are the different kinds of dogs you have named? 2. What particular characteristics fit the dog to live with man as a companion? 3. Name the different kinds that are kept as pets. 4. In what countries are dogs used as beasts of burden? Why? 5. What kinds



GERMAN SHEPHERD DOG

of dogs are used as hunters? 6. Why are dogs employed to guard sheep and reindeer? 7. Where is the home of the St. Bernard dog? 8. What fits him for the special work for which he is trained?

If you have ever owned a dog, you have undoubtedly learned to love him as a dear companion. He possesses a combination of

strength, intelligence, and affection that makes him the most faithful animal friend man has ever found. As you read the account of what man has discovered about the animals of this family, you will understand why he is the only one that can be trusted, and you will appreciate the reasons why the fox and wolf are valued only for their furs.

THE DOG

In all probability the dog was the first animal that sought to associate itself with the life of man, and it is evident that this treaty of friendship made between man and beast was due largely to self-interest. The great problems for both were to secure food and to find some means of defense in their struggle for existence. Man was able to provide fire for warmth, and to accumulate stores of food — two comforts that the wild animal was quick to appreciate. On the other hand, man soon perceived that the dog was an intelligent hunter and a brave, faithful protector and companion.

By many of his actions the dog shows us that his forefathers were accustomed to live in packs, for the sake of greater protection as well as for the purpose of procuring food. When first attracted to the dwelling of man, he probably looked upon the members of the family as comrades, and upon his master as the chief of the pack. His intelligence and quickness in understanding instructions were probably acquired when his forefathers hunted game that demanded the cooperation of the entire pack, each member being early trained to carry out the instructions of the leader. His manner of bolting food when eating is explained by the fact that when the pack succeeded in capturing game each dog had to fight to secure his share of the food. So to-day, the dog, regarding man as his comrade, imagines that he wishes to take the food from him for his own use.



POINTERS



YOUNG HOUNDS

To whatever part of the world man has traveled, the dog has accompanied him. His fidelity, affectionate nature, keen intelligence, and undaunted courage have made him man's best friend among animals. There are so many kinds of dogs that it would be almost impossible to group the three hundred species in any other



AFTER A LONG RUN

way than according to the position they occupy in their relation to man's life ; namely, pets, hunters, watchdogs, etc.

The kind, size, and color of the pet dog are largely matters of individual taste or fashion. The pointer, setter, and retriever are considered best among hunting dogs, on account of their intelligence, keenness of scent, and quickness of movement. All dogs that hunt have a habit of stopping for a moment before seizing



RETRIEVING FROM THE WATER



CHARGING AFTER BRINGING HOME THE GAME

their prey. Man, having observed this habit, found it an easy matter to train the dog to find game, and to indicate its location by standing perfectly motionless with his nose pointing toward the



A LONG-HAIRED DOG AND A SHORT-HAIRED DOG

prey in concealment. The retriever does not locate the game, but finds it after it has been shot. Dogs that hunt in packs are those that are noted for their speed and perseverance in following game across wide stretches of hunting ground.

The fact that man can make use of the dog in many ways is due largely to the dog's remarkably keen sense of smell. In some cities in America and Europe dogs form a part of the police force, because they are able to follow the human trail and can indicate the

hiding places of persons without doing them bodily harm. In Germany dogs have been introduced into the army. Their special duty after a battle is to search for the wounded who might otherwise be overlooked on account of the bushes or underbrush. Their natural intelligence makes it easy to train them for this work.

The polar expeditions of recent years have made us familiar with the valuable assistance the Eskimo dogs are able to give to travelers in the snowy regions of the north. In northern Siberia, where the snow covers the ground the greater part of the year, the dog team is the only means of traveling or transporting the mail. In Holland, Belgium, and some other European countries the dog is used as a draft animal, although he is physically not as well fitted to do this work as are the larger herbivorous animals.

The value of the dog to man does not cease with his life, for we find that his skin is extensively used in the manufacture of gloves and as an imitation of chamois skin.

THE WOLF

The wolf bears a strong resemblance to certain species of our domestic dog, but there are several points in which these two differ widely. The ears of the wolf are erect, or pricked, while those of the dog lop, or droop. The wolf has a bushy tail which, with rare exceptions, hangs down; the dog carries his proudly erect. The jaws of the wolf, which are armed with strong, sharp teeth, open wider than the dog's, and for this reason his teeth have greater cutting power. With the exception of the coyote, or prairie wolf, the wolf has no call but the howl, while the dog both howls and barks. There is also a marked difference in the dispositions of these two animals, the wolf being mean, cruel, and treacherous, while the faithful, affectionate disposition of the dog is what has made him man's loving, trusted companion.

The wolf is found in all parts of North America, from the central part of Mexico to the Arctic regions, except in the localities from which civilization has driven him. The gray wolf is the only species known, but the fact that the color of his hair differs in different parts of the country has won for him a variety of names.

In the far north, where his color blends with that of his snowy surroundings, he is known as the white wolf; in Florida he is called the black wolf; while in Texas he bears the name of red wolf. The coyote is smaller than the gray wolf, and when seen in the open



GRAY WOLF

prairie is easily mistaken for a dog. He is sometimes called the barking wolf on account of his fondness for giving a peculiar cry that is half howl and half bark.

During the early history of our country the wolf proved a dangerous foe to the settlers, but with the improvement in firearms

and the rapid advance of civilization he learned to shun man, so that at the present time he is feared by us only because of the harm he may do the domestic animals of the farmyard. In the northern parts of Russia and Siberia the wolf is a very ferocious animal. During the long, cold winter months they have great difficulty in finding food, and their starving condition makes them very savage. At such times they gather in great packs and become so bold that they haunt the roads in search of food. Then it is that they attack and kill horses, although they seldom attack human beings.

In countries where wolves abound they are hunted for their valuable skins. Those killed in midwinter, when the hair is the heaviest, are considered the most valuable, while the soft, fine, white skins bring the highest market price.

THE FOX

If you have ever seen a fox you will not need to be told that he belongs to the same order as the dog and wolf, for his bright little face bears a strong resemblance to both these animals. There are many species of foxes, but the ones with which we are the most familiar are the red fox, found in the northern part of North America and as far south as North Carolina and Tennessee; the swift or kit fox, whose home is in the Western plains; and the gray fox of the Southern states. Civilization has not yet succeeded in driving the fox very far from the home of man, or in making him much afraid of man. By means known only to this wise little animal himself he has learned the meaning of man's efforts to destroy him, and has found ways of outwitting him. His cunning and ability to take care of himself are shown in many ways. Sometimes, if he is caught in a trap, or in the act of robbing a henroost, he will play possum, in order to fool his captor into believing him dead, so that he may win for himself a chance to escape.

The Arctic fox belongs to the polar regions of both hemispheres. During the greater part of the year he is covered with a coat of white hair, but as the warm weather approaches, this is replaced



ARCTIC FOX

by a coat of bluish-brown hair. In the Aleutian archipelago he keeps this dark coat all the year and is called the blue fox. Another peculiarity of the Arctic fox is that the soles of his feet are covered with a coating of hair, which makes him sure-footed when traveling over

the slippery ice and frozen snow of the polar region. In certain localities the Arctic fox has been known to lay in a supply of food for use during the long winter months, when game is difficult to find. To do this he kills his prey in summer, when there is an abundance of food, and buries it in the ice for safekeeping and winter use.

The pelt, or skin, of the blue fox is so valuable that an effort has been made to preserve the species by establishing a fox farm on the Pribilof Islands in Bering Sea. During the summer, when both seal and lemming (a small rodent of the Arctic region) are to be found in great abundance, the fox can find plenty of food. It is after the seal have started south that the fox begins to suffer from the scarcity of food. Then it is that the fox farmers come to his relief. These men have built stockyards in which they place plenty of dried fish and cooked corn meal, to tempt the hungry animals to enter the yards. When they are once inside, the gates are closed. The animals are then fed, and all the females and every third male (after he has been marked for future identification) are set free. Sometimes these marked animals will return several times during the winter to get a good meal.

In the case of the blue fox the skin of the yearling and the two-year-old are considered the best for market, such skins bringing from twenty-five to fifty dollars apiece. The skin of the silver fox, a variety of red fox, is so highly valued by the furriers that zoos cannot afford to keep a living specimen, a single fine skin being worth anywhere from six hundred to twelve hundred dollars. These animals are so dainty in their choice of food, and so difficult to coax into a box trap, that fox farms have not yet proved successful.

Summary. 1. In what ways does the dog resemble the cat? 2. In what ways does he differ from the cat? 3. Which is of greater value to man, the dog or cat? Why? 4. Why should the wolf and fox be classified with the dog?

CHAPTER V

RODENTS

SPECIAL STUDY OF THE SQUIRREL

Examine the outline of classification (p. 189) and determine to which subkingdom, class, subclass, and order the squirrel belongs.



SKULL OF SQUIRREL

From Linville and Kelly's "General Zoölogy"

From this study of the outline give the four distinguishing characteristics of the squirrel.

Under a picture of the squirrel make a record of these distinguishing characteristics.

Observation work.

From your observations of the squirrel state what you have learned about his

food ; about the way he eats. Examine the sketch of the squirrel's mouth and note how his teeth differ from those of the other animals you have seen, in kind, number, and the position of each kind.

Make a record of these facts, to show the adaptation of the squirrel's teeth to his habit of eating.

Notice the peculiar way the squirrel uses his forefeet. How do they differ from the feet of the dog and cat? How do they compare with your hands? Why is he able to hold his food to his mouth while he eats? Think of the different ways in which it is an advantage to the squirrel to have long, slender toes and claws. Compare the front and hind legs and note their length. What difference do you find? What other animal has hind legs like the squirrel? How do his hind legs aid him in jumping?

From these observations make a summary of the facts that show how the feet and legs of the squirrel are adapted to his habits of climbing and gathering food. Name the different kinds of squirrels. Make a list of all the wild animals that are like the squirrel. Illustrate this list with pictures, to be used in connection with the written descriptions.



SQUIRREL'S FOOT

Among the rodents there are some with which you may never have an opportunity to become acquainted. For this reason you will be interested in the stories that tell why the rabbit has proved so destructive to crops in Australia, and how the beaver cuts and prepares the materials with which he builds dams and houses.

SQUIRRELS AND CHIPMUNKS

The red and gray squirrels are the ones most commonly found in our woods, though occasionally a black one, or more rarely a white one, is captured. These animals are so dainty in their habits, so swift and graceful in their movements, that every one admires

them. Their long, bushy tails are broader and flatter than those of the gopher, chipmunk, or other ground rodents. This tail, which adds so much to his beauty, aids the squirrel when he leaps or falls through the air, and when he sleeps he wraps it about him like a cloak. Before cold weather comes the gray squirrel has gathered his supply of food and hidden it away, burying it under



PRAIRIE DOGS

A species of ground rodent

leaves or in the ground, or storing it in a hole in the trunk of a tree. The red squirrel does not do this, for he prefers to gather his food day by day, no matter what the weather may be, sure of finding enough seeds for a good meal out of the cones, frozen apples, and maple keys that are left hanging on the trees.

The flying squirrel is much smaller than either the gray or red squirrel and is seldom seen in the daytime. He gets his name

from the growth of skin that extends from the fore to the hind legs and acts like a parachute when he makes his daring leaps through the air, giving him the appearance of flying. When they leap from branch to branch, all tree squirrels straighten out the body so as to present as large and flat a surface as possible to the air. They stiffen their arching tails and, with quick, tremulous movements of legs and tails, come down so slowly that they escape all injury.

The chipmunk is easily distinguished from the red squirrel by the stripes that mark his sides. Long before it is time for the snow to fall, the chipmunk digs his burrow in the ground, a foot or two below the surface. In digging this hole he brings up all the dirt in his cheek pouches, and in the same way he carries in the dry leaves with which to line his burrow. Here he stores enough nuts, corn, and seeds to last him during the winter. The chipmunk will disappear about the last of December and remain hidden in his burrow until March or April, but he likes to know, before he goes to sleep, that he has plenty of food on hand for a good meal whenever he awakens from his nap during the long, cold months. There is one other respect in which the chipmunk differs from other squirrels, and this is that each one lives by himself, preferring a life of solitude to the family life of the gray squirrel.

THE RABBIT

The original home of the rabbit was in Africa, from which country they were carried into Spain. From there they spread through all the countries of Europe, wherever they could find food in abundance. The home that the rabbit makes is a burrow. This he digs in the ground with his feet, carefully hiding the entrance with a mat of dry grass and dirt. The little ones are born naked and blind, and are not able to see until they are ten or twelve days old.

They do not leave the nest until they are a month old. The mother then takes them out to nibble grass. She does not stay with her little ones during the day, but at nightfall returns to feed them. Before leaving the burrow she is very particular to hide the entrance, so as to prevent the male rabbit from finding her babies, as he has been known to eat the young when there was a scarcity of other food.

About fifty years ago rabbits were introduced into the southern part of Australia by English settlers who had hunted them in their home country. The soil and climate caused them to multiply more rapidly in Australia than they had in England. It would be impossible to give any idea of the vast numbers that are to be found in Australia at the present time. It has been estimated that a mother may have 1,250,000 offspring at the end of four years.

They have multiplied so rapidly that they have become a pest. In some parts of New South Wales they are "eating out the sheep," as the farmer says, for the vast army of rabbits is eating all the grass intended for the sheep.

In its efforts to find some means of exterminating them, the government offered a certain sum of money for each scalp that was brought in, but this plan did not succeed, for men found that it paid to raise rabbits for their scalps. The farmers tried putting wire fences about their fields, but the rabbits soon discovered some means of getting under or through these fences. The tank trap has been the only thing that has succeeded in destroying them in any numbers. With these traps as many as twenty-three thousand have been caught in a single week during the dry season.

New surroundings have caused the rabbit to change some of his habits. For instance, in California he has forgotten how to burrow, while in Australia he has developed long claws which enable him to climb low trees and shrubs in search of food when there is a scarcity of grass.

There are certain parts of Europe where the poorer class of working people eat the flesh of the rabbit, but in countries where he is looked upon as a pest the flesh is not eaten. In France the Angora rabbit is raised for his beautiful fur, the hair being frequently over four inches in length. These skins are in great demand, the fur being used for gloves, stockings, and many other things. Other rabbits whose skins are of value to the furrier are the silver rabbit, so called from the color of his fur, the Russian rabbit, which is all white except his jet-black ears, nose, paws, and tail, and a rabbit with dark-blue fur that is found in Flanders.

THE HARE

Many people in the West speak of the "white rabbit" and "jack rabbit" when they really mean the white hare and jack hare. They make this mistake because they do not realize that there is any real difference between the hare and rabbit. If you have an opportunity to see these animals side by side, you will notice that the hare is larger than the rabbit, that he has longer ears, longer legs, and is a much swifter runner. We also learn that these animals differ in many of their habits, for the hare hunts at night and is seldom seen during the day, while the rabbit hunts only during the day. The hare makes a nest aboveground for her young, while the rabbit always digs a burrow in the ground. Another difference is that the young hare is born with its eyes open and is covered with fur, while the rabbit is born blind and naked. The flesh of the hare is considered much better food than that of the rabbit.

In the southwestern part of California, Belgian hares are raised extensively for market. These animals are so clean in their habits that they can be kept healthy even when raised where they have

but little space in which to run about. It costs little to raise them, as they live chiefly on alfalfa and clover hay, and are full grown when eight months old.

THE BEAVER

In certain parts of Canada and the United States the first permanent settlements were made by men who came to America to engage in the fur trade. In their search for fur-bearing animals they soon discovered that the beaver existed in large numbers and that its rich fur commanded a high price. It is said that a load of beavers' skins formed one of the first cargoes of merchandise sent by these colonists to the mother country. The success of the first fur traders influenced others to come to America, and thus it happened that the beaver played quite an important part in the colonization of these regions.

In those early days beavers were found in nearly every part of North America, but the gradual settlement of the country drove them to the wilder and less accessible regions. At the present time they are found only in small numbers in certain sections of our Northern states, while in the thickly wooded parts of the Hudson Bay region and in the northern peninsula of Michigan they have multiplied rapidly.

A marked peculiarity of beavers is that they always live in families consisting of two old beavers and from four to eight young ones. The old beavers keep their young with them for two years, or until they are fully grown, when they are driven out and forced to make homes for themselves. Many animals build homes, but no other animal builds so many and varied artificial structures for comfort and protection as does the beaver. The skill which he displays in building dams, lodges, and artificial canals, to say nothing of his skill in felling trees, has always excited the wonder and admiration

of man. It is even claimed that certain tribes low in the scale of civilization, such as those found in Tierra del Fuego, model their huts after those built by the beaver.

The dam is the most important structure that the beaver builds, on account of its size, the length of time required for its completion,



AMERICAN BEAVER

and the watchful care necessary to keep it in repair. His object in building a dam is to regulate the depth of water in the pond, for this must always be deep enough to hide the entrance to his home, as well as to serve as a place of refuge when he is pursued by an enemy. These strange little animals build two kinds of dams. One is called a "stick dam," from the fact that the interwoven sticks are

never covered on the downstream side ; the other is known as the "solid-bank dam," because the material of which it is built is so hidden by a plaster of mud and earth that it has the appearance of a solid bank of earth. The stick dams are the more common and are usually built in brooks and in other streams where the banks are low. These dams are much wider at the base than at the top, and although they may not be very high when first built, they are frequently raised to a height of six or seven feet by the addition of new material used each season in making repairs.

A family of beavers will almost always build both a lodge and a burrow, the first being their home and the second their hiding place in time of danger. The lodge is usually built a few feet back from the edge of the bank, is conical or dome-shaped, and contains but one room. The frame of the lodge is made of poles and sticks interwoven, the smaller ones being inserted between the larger in such a manner as to hold them in place. The whole framework is then covered with clods of earth, stones, and twigs, while the crevices are stopped with a plaster of earth and clay that has been dug from the bed of the pond or stream. All the poles and sticks used in building are first trimmed of their branches and then stripped of their bark. Each season the inside of the lodge receives a fresh coating of mud, and the weak places in the roof are strengthened on the outside by the addition of wood that has been stripped of bark. Nothing has ever been found in these lodges but the fine wood fibers or fresh-cut grass used for bedding.

As a rule there are two or more entrances to each lodge. One is straight, with its floor rising gradually from the bottom of the pond to the floor of the lodge. This is known as the "wood entrance," and through it the beavers carry all the wood cuttings upon which they feed. The other rises more abruptly from the bottom of the pond, is not always straight, and is the entrance commonly

used by the family. The burrow is an excavation in the bank of the pond, the entrance to which is usually under the roots of some old tree below the surface of the water. For this reason the burrow is difficult to find and makes a secure hiding place.

In felling trees or cutting branches to be used in building, the only tools with which the beaver has to work are the two large cutting teeth on each jaw. These are nearly triangular in shape and extend so far into the jaw that the lower ones pass back and under the roots of the molars. This peculiarity is what makes the teeth so strong and enables the beaver to gnaw the hardest wood. The upper teeth are much shorter than the lower ones, and serve merely to hold the wood, while the lower ones do the cutting. The enamel grows only on the front of these teeth, and for this reason the soft dentine of the inner edge wears away faster than the hard enamel on the front, and the edge becomes chisel-like. A peculiarity of these teeth is that they grow from the roots as rapidly as they are worn off at the tip. If one of these teeth should be broken, the tooth opposite, having nothing to work against, would soon grow so long that it would extend beyond the jaw and be very troublesome to the animal, especially in eating.

In cutting down a tree the beaver sits up erect on his hind feet like the bear. Two beavers usually work together, one doing the cutting, the other acting as guard. Commencing about a foot from the ground, the beaver gnaws around the trunk until it is cut in more than halfway to the center. He makes the rest of the cuttings with reference to the direction in which the tree is to fall. It is said that two full-grown beavers will fell a tree measuring two feet in diameter in two or three nights.

Since the beaver does not hibernate, it becomes necessary for him to lay in a store of food for use during the winter months, when the streams are frozen over and dangerous foes threaten

him on every side if he ventures forth on land. The food that he prefers is the bark of the small twigs of the yellow birch, cottonwood, poplar, and willow. He also eats the bark of the white maple, the bird's-eye maple, walnut, and ash, the roots of the pond lily, and coarse grasses that grow along the shores of ponds. As soon as the tree has been felled, the entire family go to work cutting it up and storing it away. Those branches that are between two and five inches in diameter are removed first and, after being cut into convenient length, are trimmed of their small twigs and branches. When the wood has been cut and trimmed, it is rolled or dragged over the ground to the water and floated to the place where it is to be sunk and stored for winter use.

Man has always valued the beaver for his skin, or pelt. This is worth about two dollars and fifty cents a pound, the average weight of a single pelt being about a pound and a quarter. The fur is at its best in the winter or spring. The best skins are those of beavers three and four years old. These skins are eagerly sought for, because they are extensively used in imitating the Alaska seal fur.

In the northern peninsula of Michigan the industrious little beaver found many friends who, believing that he was a harmless animal, secured his protection by having special laws passed by the legislature. Owing to this care they have multiplied until now they can be counted by hundreds of thousands. At the present time they have become such a nuisance that the farmers, lumbermen, and fishermen have asked to have the law changed, in order that they may be driven from that particular region. It is claimed that they not only destroy a great deal of timber each year in the construction of their homes and for food, but that their dams flood large tracts of timber land, in this way causing the destruction of all trees growing in the tract. It is said that "one of the largest beaver dams

in northern Michigan is near Witch Lake. Here the houses cover more than half an acre and contain hundreds of cords of wood. The water in the creek has backed up for many miles, and many acres of timber lands have been flooded."

While beavers do not eat fish, they drive them from the streams where they build, because their dams prevent the fish from passing up and down the stream, or cause the water to become so stagnant that the fish are killed or driven away. In some rivers of northern Michigan they have blocked the streams with their lodges in such a way as to cause the lumbermen great difficulty in getting their logs to market.

Summary. 1. What characteristics have the rodents in common with the other animals studied? 2. How do they differ from all other animals? 3. Which of the rodents are of value to man? Why? 4. Which of the rodents have been domesticated? Where?

CHAPTER VI

STUDY OF THREE FAMILIAR ANIMALS

THE BEAR

Examine the outline of classification (p. 189) and determine to what subkingdom, class, and subclass the bear belongs. Give your reason for each fact as you state it.

Turn to page 92 and see what the bear eats. Because of the fact that the bear eats such a great variety of food, he is called omnivorous, yet all good authorities class him with the carnivorous animals.

Observation work. Compare the feet of the bear with those of the dog and cat, to note how the toes and claws differ. Watch the bear and determine on which part of his hind foot he walks, on which part of his forefoot. What effect does this have upon the way he walks? What can the bear do that the cat or dog cannot do? How does this peculiarity of his hind feet help him to do this? Of what value is this to the bear when he meets an enemy? How does he use his forefeet when he eats? when he climbs? From these observations make a summary of the facts that show how the bear's feet are adapted to his habits of walking and of capturing his prey.

Study the picture of the bear and note the kind of teeth he has, how many, and their arrangement. Compare the front teeth with those of the dog as to sharpness. How do his back teeth differ from the dog's? If they are flatter than those of the dog, what



BROWN BEAR
Portage Bay, Alaska Peninsula

must he be able to do with them? What is his food? Make a record of the facts that show the adaptation of the teeth of the bear to his habit of eating. Make a list of the different kinds of bears. Illustrate with pictures as far as possible.

It is a well-known fact that bears hibernate during the winter months. Perhaps when we know the kind of food they eat, it may help us to understand the reason for their doing this. They eat honey, all kinds of fruit, roots, a few vegetables, ants, fish, crickets, grubs, birds' eggs, and the flesh of some animals. A glance at this list of foods shows that after the winter season sets in, the bear cannot find a sufficient quantity of food to keep him alive; therefore he must either fast or migrate to some warmer region. Before the winter snows begin to fall, the bear has grown very fat. When it is time for him to hibernate, his stomach is so filled with fat that he wishes little food except berries. In the spring, when he wakes from his long sleep, he is so weak that he can scarcely move. Before he can go in search of food, he must exercise, so as to regain the use of his legs. His first walk is necessarily short, but by increasing the length of his trip each day he soon recovers his strength. This is the time of year when he feeds chiefly on roots and tender grass.

The winter sleeping quarters of the bear are usually the trunk of some hollow tree, a cave among the rocks high up on the mountain side, or a hiding place so remote that it is not likely to be discovered. Once having found a comfortable place, he returns to it year after year. Occasionally he may be seen wandering about during the winter. In all probability this is due to his being disturbed or to his having found his hiding place so uncomfortable that he has left it to seek a better one in which to finish his nap.

The grizzly bear gets his name from the grayish-brown color of his fur. These bears are very quick in their motions and much stronger than either the brown or black bear. The mother keeps her cubs with her until they are nearly two years old. When cold weather comes they retire to their cave among the rocks, and there, curled up like great balls of fur, they sleep for about one hundred days, or during the coldest part of winter. The mother and her little ones are great wanderers, but travel mostly during the night.

The grizzly bear is extremely fond of ants, and if he had to gather them one by one he would find difficulty in getting enough to satisfy his appetite. Instead of picking them up from the ground he hunts until he finds a great ant hill, and then tears away the whole top of the hill with one blow of his huge paw. Having uncovered the ants' nest, he pokes his nose and mouth down into the opening and, drawing in his breath, sucks in vast numbers of them. By repeating this operation half a dozen times he succeeds, with very little trouble, in securing all the ants in the hill. Sometimes he will spend hours sitting on the bank of a stream or lake, watching for a chance to catch fish. When at length one comes within reach, he makes one quick sweep with his big forepaw and catches it with his sharp claws. His wonderfully keen sense of smell enables him to locate a tree that contains honey long before he can see the tree. When he reaches it, he rises on his hind legs and taps the trunk with his strong claws until a hollow sound tells him the location of the honey. Having found the exact spot, he proceeds to claw and chew the bark and wood until he makes an opening in the trunk. When this opening is large enough, he thrusts in his forepaw and brings out a handful of the honey, which he licks from his paw with keen pleasure, in spite of the swarm of angry bees that sting him in their efforts to drive him away from their home.

The snow-white fur of the polar bear serves as a protection as he travels over the snow fields of the North. While the young cubs follow their mother for one or two years, and frequently keep together for some time after leaving her, the old bears, as a rule, prefer to live alone. Their food consists principally of the flesh of the seal and walrus. When these cannot be found, they will eat the larger kinds of fish. Their habit is to remain quiet during the day and spend the hours of the night wandering in search of seals. Although they are expert swimmers and excellent divers, they are not able to catch the seal while it is in the water, but must seek it when it is on the ice ; then a single blow of the powerful forepaw is sufficient to kill it.

The fur of the bear is too coarse to make the skin useful except for rugs, and the flesh is of little value as an article of food. Except as game for the sportsman, the bear seems to be a useless animal, one that the settlers in the West would gladly see destroyed, on account of the damage he does to their stock.

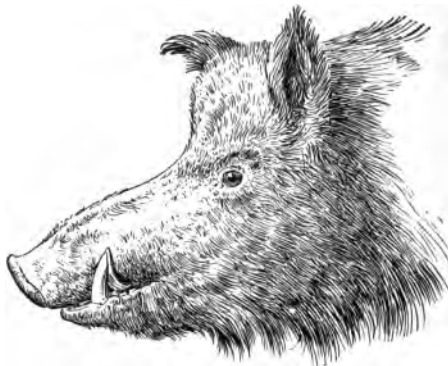
Summary. 1. Why would you not group the bear with the herbivorous animals? 2. What peculiar characteristic would lead you to group him with the carnivorous animals? 3. Which bear belongs to the polar regions? 4. What fits him to live there? 5. Which bears are found in the United States? 6. Is the bear ever found in the tropical regions? 7. Which kind is considered the most dangerous?

THE PIG

After examining the feet of the pig, decide to what order he belongs. Give three other distinguishing characteristics of the pig. What term is frequently applied to the pig on account of the variety of his food? Make a record of the distinguishing characteristics of the pig, giving your reasons for each statement.

Observation work. Note the general shape of the pig's body. What does it resemble? Where did his ancestors live? How would this peculiar shape of body aid the pig to penetrate the underbrush and move through swampy regions? Examine the teeth and compare them with those of the bear in kind, number, and arrangement. How do they differ from those of the horse? from those of the dog? What is peculiar about the way the pig uses his snout? How is it adapted for this purpose? Under a picture of a pig make a summary of the facts that show the adaptation of the pig's body to his surroundings; his teeth to his habit of eating.

Study the foot of the pig, to note what animal's foot it most closely resembles. In what respects does it resemble that of the cow? How does it differ? How are the large toes used in walking? Of what special value are the small toes? In your notebook make a record of the facts that show the adaptation of the pig's feet to his habits of walking. Illustrate with a sketch of the foot.



HEAD OF WILD BOAR

The pig is the one domestic animal that during life renders man no service for his care. He merely eats, sleeps, and grows fat. Yet in spite of this fact, he is, if properly cared for, one of the best-paying domestic animals that man can raise, although his value is not realized in dollars and cents until after he is killed.



A MOTHER AND HER LITTLE ONES

The pig was one of the first domestic animals introduced into America, having been brought here by the early Spanish explorers. One circumstance that led to the introduction of a fine breed of hogs is told in the following amusing story. The Duke of Bedford, wishing to make General Washington a fine present, sent him a pair of pigs.

They were intrusted to

the care of an English farmer traveling to America. The farmer realized the value of the animals committed to his care, and instead of delivering the gift, leased some land and began the breeding of these choice animals, sure of finding a ready market for all he could raise.

It is an easy matter to trace some of the peculiarities of our domestic animal to habits acquired by his ancestors while living in a wild state. The wild



SHOWING THE RESULTS OF GOOD CARE

hog lived in places that were moist and covered with dense forest growth. His thick, round body, with sharp, pointed snout, helped him force his way through the dense jungles, while the tough skin, with its bristly covering, protected him from the briers and brambles of the undergrowth. The length of the hog's snout is probably due to his having such a great number of teeth, while the shape is the result of his habit of pressing his nose against the ground while searching for food.



A CLEAN HOME

The two toes that are just behind and above the hoof are somewhat larger than those of the cow. Although these toes touch the ground only when the soil is deep, there can be no doubt that they give the animal more secure footing when running over rough or uneven ground.

As a rule the pig does not squeal unless alarmed, for this was the call by which the wild animals summoned the other members of the herd to their assistance. The grunt, which we interpret as a

sign of satisfaction, was their device for telling their neighbors where they were, so that all might keep together while feeding.

One of the most valuable qualities of the pig is that he is easily fattened. During the spring and summer the wild hog was content to grub for food, but in the fall he fed exclusively upon the ripening acorns and beechnuts, so that he might lay on fat as a store of food to carry him through the severe winter. If the pig is given plenty of corn to eat, pure water to drink, a good pasture in which to graze, and a clean bed in which to sleep, his flesh will be wholesome and nourishing. The flesh of the pig is more easily preserved than that of any other animal, and for this reason it is well fitted for use on long sea voyages or in countries where fresh meat is scarce or difficult to keep.

Questions for thought. 1. For what is the coarse hair of the pig used? 2. Is the skin of any value? 3. For what is it used? 4. What is the fresh meat of the pig called? 5. How is pork preserved? 6. In what other ways is the flesh prepared for market? 7. Why is it so extensively used for sea voyages and in countries where fresh meat cannot be had? 8. How does the pig compare in usefulness and value with other domestic animals?

THE ELEPHANT

If you look at the elephants found in the zoo or circus, you will discover that there is a difference in the shape of their heads and in the size of their ears, showing that there must be two distinct species. The African elephant, the one with the large ears, is found south of the Sahara, in the central part of the continent. The Asiatic elephant is found in India, Burma, Siam, the Malay Peninsula, Ceylon, Sumatra, and Borneo.

The history of India shows us that elephant hunting has been carried on from very early times. It was the custom of the Indian



INDIAN ELEPHANT

prince or nobleman, who wished to show how rich he was, to keep as large a train of elephants as he could afford, for use in all ceremonial processions. The less valuable elephants he had trained for work.

Elephants travel in herds, each herd consisting of a family numbering from thirty to fifty or even one hundred. The herd is usually led by a female, so that the mothers may regulate the length of the march and select the places for rest and feeding that are best fitted to meet the needs of their young. At the first sign of danger the bulls rush to the front to protect the rest of the herd. A herd will so quickly clean out a new feeding place that they can halt but a day or two at a time. When there is a scarcity of food, the herd sometimes divides into small parties of ten or twenty. Their sense of smell is so keen that these small parties, which keep within two or three miles of each other, can quickly assemble when it is necessary to resume the march. When traveling, they usually rest from about ten o'clock in the morning until the middle of the afternoon, and from eleven o'clock at night until about three in the morning. If the weather is cool and showers are frequent, they will sometimes travel all day without stopping to rest. They march one behind the other, in Indian file, making a broad, well-beaten trail about a foot and a half wide. Their huge feet are so like great rubber cushions that, in spite of their size, they can move along the trail without breaking a twig or making a sound.

Hunters who have made a study of wild elephants say that when they travel through a country new to them, they advance with great care. If they come to a region which they consider dangerous, they send out scouts and spies to examine the country. Whatever information these scouts get they are able to communicate in some way to the other members of the herd. Sometimes

the news they report causes a retreat to be ordered. This they perform in perfect silence, like a company of savage warriors. The only time the elephants make a noise is when an open attack is made upon them by some enemy. Then the breaking of trees and branches as they go crashing through the jungle in their



HEAD OF INDIAN ELEPHANT

wild stampede makes a noise that is terrifying even to the bravest hunter. The wild elephant is a restless animal, and as long as he is awake he keeps swinging first one foot then another, while keeping both tail and trunk in almost constant motion. The elephant cannot run; he can only shuffle along at a fast walk of perhaps fifteen miles an hour, and even this speed can be kept up for only a short time. His great size and weight, and the peculiar

formation of his hind legs, make it impossible for him to make the slightest spring.

The tusks are never used in collecting food. If the elephant wishes to overturn small trees, he pushes either with his feet or the base of his trunk. The pressure of his heavy foot is sufficient to crush the trunk of the palm tree or to break the plantain which he seeks for food. The tusks are used for defense. They show almost from the hour of his birth. It is believed that these first tusks are permanent, and that if they are injured they will not grow again. They are so placed in the jaw as to enable the elephant to strike a blow with them at almost any angle. The power and influence of a bull depends upon the size of his tusks, the one with the largest tusks being looked upon by the others as a superior animal.

The elephant uses his trunk to gather food and to put it into his mouth. When thirsty, he fills the lower end of his trunk with water, curls it backward, puts the end into his mouth, and blows the water down his throat. If anything should happen to injure the trunk, so that he could not drink in this way, he would be forced to wade into the water until it was on a level with his mouth before he could drink as other four-footed animals do. The trunk is such a delicate, sensitive organ of touch and smell that it serves to warn the elephant of danger. In spite of his great size and weight the elephant is an expert swimmer. One writer says, "They have been known to swim six hours without touching bottom, then after a rest on a sand bank to swim on for three hours longer."

In India four different methods of capturing elephants have been used. If a whole herd is to be captured, a keddah, or inclosure, is built. "This is formed of stout uprights about twelve feet high. They are arranged in a circle of from forty to fifty yards in diameter. These are strongly backed by sloping supports and binders

behind. An entrance of four yards in width is left for the herd to pass through. The inclosure is built on one of the elephants' chief runs, and in a spot where the thickness of the cover screens it. Two lines of strong palisades are run out from it on either side of the path by which they approach. When the herd is once within this approach it is easily driven forward by the beaters closing in from behind. After they are in the keddah, tame elephants are used to secure the wild ones by separating them one by one from their companions, when their hind legs are tied together by one of the drivers. A rope is then secured around each captive's neck and another to one hind leg, and they are led out and picketed in the forest near the keddah, until they have become sufficiently tame to remove."

If single elephants are to be captured, they are hunted by digging pitfalls, or by noosing them from the backs of trained elephants. It requires from three to four months to tame completely a wild elephant. The larger and older ones are more easily tamed than the young ones, because they are not so timid.

Elephants live to a good old age, and at sixty are considered to be in their prime. The wild animal does not attain his full growth until he is between twenty-four and thirty years of age, although in captivity he attains his growth by the time he is twenty-four. It has been claimed that the elephant is the most patient and obedient, as well as the most intelligent, of animals. The fact that he is capable of being taught, and is willing to obey after he has been taught, makes him of great value as a work animal.

Trained elephants are kept both by the government and by private parties, to drag timber from the forest and to pile it at the dépôts. They are also used for carrying and drawing heavy pieces of artillery, and are particularly useful in military campaigns that have to be carried on in mountainous regions.

With the gradual settlement of the southern part of Africa the elephant has been driven north toward the heart of the continent. Here they have been so persistently hunted for their ivory that, unless something is done to protect them, there is danger that in time the African elephant will be exterminated.

Summary. 1. Name three characteristics that the bear, pig, and elephant have in common with the horse, cow, dog, and cat. 2. In what respect does the bear differ from them all? 3. Which is he more like, the herbivorous or carnivorous animals? Why? 4. Could the bear be domesticated? Why? 5. Would he be of any value to man if he were? Why? 6. How does the pig differ from the other hoofed animals? 7. What kind of care should be given to the pig if he is to be made of greater commercial value to man? 8. What three characteristics distinguish the elephant from all other animals? 9. Why does it not pay to raise elephants?

CHAPTER VII

THE STUDY OF BIRDS

Examine the outline of classification (p. 189) and determine to which subkingdom and class the bird belongs. How do the fore



MALLARD DUCKS

limbs of the bird differ from those of all other animals? Determine in what ways the wings are of special value to the bird in moving, feeding, and as a means of protection. In your notebook

make a record of the distinguishing characteristics of the bird, and of the facts that show the adaptation of its wings to its habits of life.

Make a list of all the birds found in and about the place where you live. Group them according to the place where they spend most of their time. Copy these lists in your notebook.

BIRDS GROUPED ACCORDING TO THEIR HABITAT	
Water birds	Land birds

WATER BIRDS GROUPED ACCORDING TO THEIR PECULIAR MANNER OF SECURING FOOD		
Swimmers	Waders	Divers

WATER BIRDS

SWIMMERS

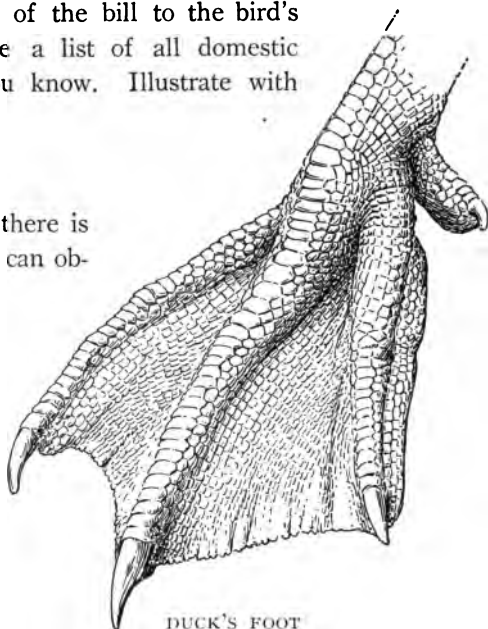
Observation work. Take any stuffed bird that belongs to this group and examine it, to note its adaptation to its habits of life. Study the shape of the body and think of the special value of this particular shape. Note the position of the legs. How does this aid in swimming? in diving? Notice the length of the neck with reference to its value to the bird in getting food. Study the toes and note their number, length, and how they are connected. Make a record of facts showing the adaptation of the body and feet to its habits of swimming and diving for food.

Study the bill, to note its size, length, tip, and any peculiarity of its edge. Make a sketch of the bill and record the observations

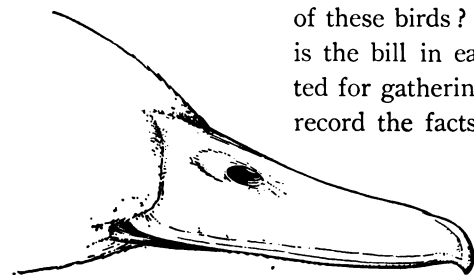
showing the adaptation of the bill to the bird's habit of eating. Make a list of all domestic and wild swimmers you know. Illustrate with pictures.

WADERS

Observation work. If there is no living bird that you can observe, study any stuffed specimen that belongs to this group. Examine the neck and legs, to note their relative length. Of what value is this length to the bird? Examine the toes, to see how they are connected. Study the bill of the flamingo



DUCK'S FOOT



DUCK'S BILL

and the heron, to find how they differ in shape. What is the food of these birds? Where is it found? How is the bill in each instance especially fitted for gathering food? In your notebook record the facts that show the adaptation of this group of birds to their habits of gathering and eating food. Illustrate as far as possible with sketches of the feet and the bill. Make a list of all the waders you know or have heard about. Illustrate with pictures.

DIVERS

Observation work. This group of birds can be studied from a stuffed specimen. If this is not available, a good picture may answer. Study the shape of the body and determine which bird, the wader or swimmer, it is most like. Note where the legs are attached to the body and think how this aids the bird in swimming or diving. What is peculiar about the tail of the diver? Why is it not needed? Compare the feet with those of the swimmer, to note points of similarity. Study the bill to note how it differs from that of the swimmer. Make a record of these observations, to show the adaptation of this group of birds to their habits of life. Make a list of all the divers you have heard about. Illustrate with pictures as far as possible.

LAND BIRDS

LAND BIRDS GROUPED ACCORDING TO THE PLACE WHERE THEY SPEND MOST OF THEIR TIME	
Ground Birds	Aërial Birds

GROUND BIRDS

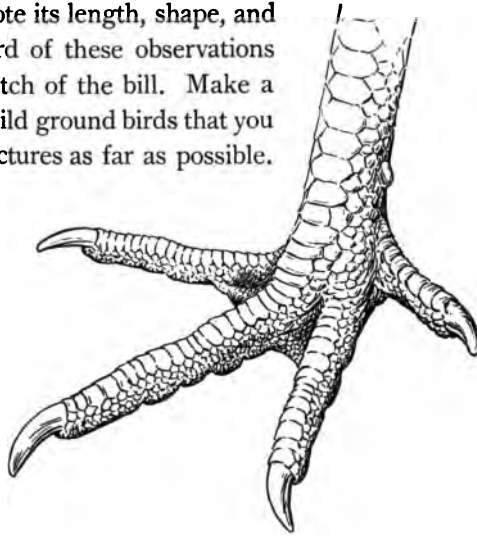
Observation work. Study either the pigeon or chicken as a good illustration of this group of birds. Examine the feet, to note the number and length of the toes, the length and position of the hind toe, the kind of claws. Determine the value of these claws. Make a sketch of the foot and record your observations showing the adaptation of the foot to the bird's habits of walking and scratching for food.

Examine the bill, to note its length, shape, and thickness. Make a record of these observations and illustrate with a sketch of the bill. Make a list of the domestic and wild ground birds that you know. Illustrate with pictures as far as possible.

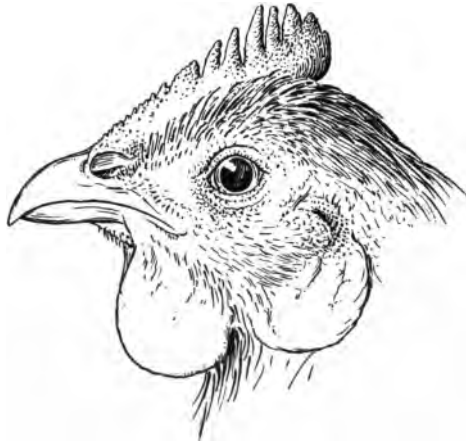
AËRIAL BIRDS

Observation work.

Study the English sparrow as an illustration of this group. Examine the feet, to note the number, length, and position of the toes. Study the bill of the woodpecker, to note its adaptation for getting food. Study the bills of the nighthawk and owl and compare with that of the woodpecker. What is the food of the robin? the flicker? the swallow? Where do these birds find their food? Make a sketch of the foot and bill of the sparrow and record the facts that show how they are adapted to the sparrow's habits of life.

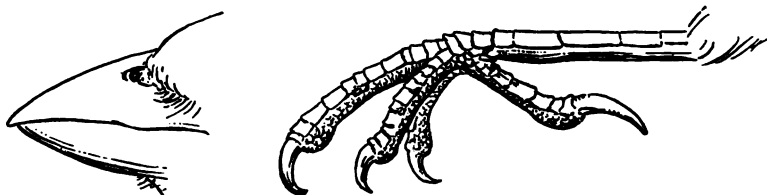


FOOT OF CHICKEN



HEAD OF CHICKEN

Make a summary of the different kinds of food eaten by the aerial birds that you know about. Name the different places where insects are found. What birds eat such fruits as the cherry and



SPARROW'S BILL AND FOOT

strawberry? Which part of the fruit do they eat? Does this injure the seed of the fruit? Why? What do the sparrows eat? Do they scatter or destroy the seeds? What do owls and hawks eat? Group all the land birds according to their food. Copy these lists in your notebook.

INSECT EATERS		
Ground Insects	Tree Insects	Insects of the Air

SEED EATERS	
Seed Scatterers	Seed Destroyers
Flesh Eaters Birds of Prey	Vegetable and Flesh Eaters

Geographical distribution. Make illustrated lists of the following: those birds that are peculiar to the polar regions; those that are found about the tops of very high mountains; those peculiar to the tropical regions; the birds of the temperate regions. Group separately the summer and winter birds that belong to the temperate regions.

A BIRD CALENDAR

In Chapman's "Handbook of Birds" is a list of the birds found in the vicinity of New York City, together with the dates of their arrival in the spring and of their departure, arranged in the following way :

DATE OF ARRIVAL		DATE OF DEPARTURE
Feb. 15-March 10	Purple Grackle	Nov. 1-30
	Rusty Blackbird	April-May
	Red-winged Blackbird	Nov. 1-30
	Robin	Nov. 1-30
	Bluebird	Nov. 1-30
March 10-20	Woodcock	Nov. 1-30
	Phoebe	Oct. 20-30
	Meadow Lark	Nov. 1-30
	Cowbird	Nov. 1-30
	Fox Sparrow	April 1-15

By writing to the ornithologist of the United States Department of Agriculture, Washington, D.C., it may be possible to obtain a similar list of the birds found in your own locality. Watch for the arrival of these birds and keep a "bird calendar," so that from your personal observations you may become acquainted with the more common birds of your own locality.

The size of a bird is one of the first things to determine, and as the English sparrow is the bird most available for study, it would be well to take him for your standard of comparison. In estimating the size of a bird the measure is taken from the tip of its bill to the end of the longest tail feather. The English sparrow measures 6.33 inches in length. The following headings are suggested in making your bird calendar.

Name	Date of Arrival	Place where seen	Size	Color	Remarks
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THE USEFULNESS OF BIRDS

Seek the children, little book :
Bid them love the bird's retreat,
By the brook and woodlawn nook,
In the garden, in the street,
In the tree above the shed,
Underneath the old barn eaves,
In their bed high overhead,
Where their crazy quilts are leaves.

GRINNELL, "Our Feathered Friends"

Man's task of domesticating birds began long years ago, and what more attractive picture of country life can be found than that



A DOMESTIC BIRD

afforded by the gathering of chickens, ducks, geese, and turkeys in the farmyard at feeding time? History traces the origin of the domestic hen to Asia, where in the dense forests of India, south of the Ganges River, lives a small jungle fowl from which, it is believed, our barnyard chickens have descended. These wild birds are much smaller than the

domestic ones, but in other respects they bear a close resemblance to them, for the rooster crows, the hen cackles, they all scratch for food, the young cocks are vigorous fighters, and the hen steals her nest and guards her young with the same jealous care that is noticed in the domestic hen. Not only are chickens descendants of

wild fowl, but the ducks, geese, and turkeys, known as "poultry," are also descendants of the wild birds that man has caught and domesticated for the sake of their eggs, flesh, and feathers. Other wild birds that are sought for this same purpose are those known as "game birds."

It is the habit of wild fowl to lay from a dozen to fifteen eggs early in the spring. After these have hatched and the young are able to take care of themselves, a second brood is raised if the conditions are favorable. Thus the wild fowl is accustomed to lay some thirty eggs each year. Having discovered that if the eggs of any bird are stolen or injured the female will continue to lay until she has the usual number in her nest, man has so changed the conditions under which the domestic hen lives that well-cared-for hens will lay from one hundred and twenty to one hundred and fifty eggs in a year.



GEESE

There are also large numbers of wild birds that are sought for their eggs, which are collected in great quantities for market. Among these are the gulls and terns found along the New England coast. The eggs of the murre, found in great numbers in the Farallon Islands, are collected and shipped to market in San Francisco. In some of the Hawaiian Islands the eggs of the albatross are found for sale in the local markets.

It is a well-known fact that without the assistance of birds all trees and crops would be destroyed by the countless insects that feed upon the green vegetation. That birds render man invaluable assistance is shown by the following facts taken from "Useful Birds and their Protection," by Mr. Edward H. Forbush. "In the year 1847 the cuckoos saved a great forest near the central part of Prussia from being destroyed by caterpillars. That same year the crops in Utah were destroyed by crickets, and when the same disaster threatened the crops the following year, great numbers of gulls suddenly appeared and destroyed the crickets. In 1865 countless numbers of locusts hatched in Nebraska, and would have destroyed the crop of corn and cereal grains but for the attack made upon them by the plover and yellow-headed blackbird. In 1897-1898 a forest caterpillar made its appearance in New York and in some of the New England states and threatened the destruction of the trees, but the warblers, orioles, sparrows, robins, and cedar birds, finding them good food, made an attack upon them and succeeded in clearing the forests of the pest at the end of the third year. Owls, hawks, and crows have frequently proved their usefulness by destroying field mice that multiplied so rapidly as to threaten the destruction of crops."

While learning to recognize the common birds, try to understand the true value of their activity as they flit from branch to branch, for all through the year birds are real caretakers of our trees. Their spring migration comes at the time when awakening insect life threatens to do harm to the new growth. Since they travel in large flocks and stop to rest and feed during the day, they can quickly clear the trees of many injurious insects. Later in the season the birds that are summer residents are busy rearing their young, and gather insects in such numbers that they keep the trees clean. In the fall the migrating birds, stopping to feed wherever an abundance of

food is to be found, quickly dispose of many of the insects that the summer birds have left. The jays, nuthatches, woodpeckers, titmice, creepers, and kinglets are among the birds that remain in New York and New England all winter. These devote their time to searching for such forms of insect life as may be hidden in the trunks or branches of the trees. Thus we see that each season brings its own special group of birds to care for the trees by eating the insects that are injurious to growth.

Those birds that feed chiefly on fruits and seeds are useful to man in two ways: they may eat the fruit and drop the seeds, thus scattering them far and wide over the land; or they may feed on the seeds of weeds and, destroying them, kill thousands of harmful plants. The jay and crow are extremely fond of certain kinds of nuts, and these they hide for future use. In this way nut trees often spring up in unexpected places.

Twice a day boats containing garbage that has been collected in the city of New York go down the bay to dump their loads. Immense flocks of gulls, numbering from one hundred thousand to one million, follow these boats to feed upon the refuse that floats upon the water. If it were not for these gulls, much of the waste material would be washed back by the tide and left on the shore to decay or to poison the water of the harbor. We should realize the invaluable work that the gulls are doing as scavengers, and, for this reason if for no other, they should be protected from those who seek to destroy them for their feathers.

Among the sea birds there are some that breed upon lonely islands far from the home of man. These feed mainly upon animal food found in the sea. Near the coast of Peru there is a group of three islands which birds have made a breeding place for countless ages. The surface of these islands has become thickly covered with the excreta of the birds mixed with the remains of

fish, birds, and other animals. Lying in the rainless region of the Pacific, there have been no rains to wash the deposit away as it dried, so it has been collecting through all these years, and now covers the islands to a depth of ninety or a hundred feet. About three hundred years ago the Indians of Peru discovered that this deposit of guano, as it is called, was a valuable fertilizer of the soil. Since that time they have guarded the birds and islands with jealous care.



GULLS

Experiments in England in the use of guano as a fertilizer were first tried about seventy years ago. These proved successful, and the people learned that by using guano they could raise more and better crops on their lands, because it gave back to the soil the nitrogen and other materials that had been used up by the growing plants. When they understood what substances guano contained, they experimented until they learned to manufacture other kinds of fertilizers. After a few years Peruvian guano became so

expensive that the United States government decided to seek for other guano islands. At the present time our government owns about seventy-five islands in the South Pacific Ocean that yield guano in large quantities.

THE MIGRATION OF BIRDS

And above, in the light
Of the star-lit night,
Swift birds of passage wing their flight
Through the dewy atmosphere.

I hear the beat
Of their pinions fleet,
As from the land of snow and sleet
They seek a southern lea.

LONGFELLOW, "Birds of Passage"

One of the first signs of spring is the honking notes of wild geese as they journey north to their summer home. During the early spring thousands of familiar birds return to spend the summer with us, and thousands of others pass us by, or stop for a day or two to rest. The same birds are usually seen a second time in the early autumn, when they are on their way south for the winter. This long journey, of sometimes several thousand miles, is taken in the spring for the purpose of rearing a family. When this is accomplished the birds are ready to return to the land that promises them warmth, food in abundance, and the shelter of green leaves.

Have you ever felt the sudden hush in the out-of-door world about you, and realized that the uncomfortable stillness was due to the departure of the birds that were with you but yesterday? If so, and you wonder why the birds leave your home region, watch and learn what the robin or bluebird eats, then think how impossible it would be for them to gather this food when the ground was frozen

or covered with snow ; think what would become of the insect-eating birds after the insects go into winter quarters. It is noticed that when the bluebird arrives in the spring the male bird comes some little time before the female does. This is true of many birds that migrate. The old males lead the way and are followed by the females and the young birds. That we do not more frequently see large flocks of birds as they migrate is due to the fact that most of them fly during the night, and at a great height. This night migration not only serves to protect them, but gives them an opportunity to rest and feed during the day. Flocks of ducks have been noticed flying at a height of a thousand feet, and going at the rate of forty-eight miles an hour. It is probable that they fly at such heights to gain a broad view of the country over which they pass.

The birds that remain with us during the winter are either those that summer much farther north, or those that are not strong enough, on account of their youth, to undertake the long flight with the rest of the flock. These birds seek shelter in thick, swampy regions, where they can find protection from the winter storms and secure food in greater abundance. It is such birds as these that need help and care in time of severe storms. Places of shelter and plenty of food should be provided, so that the birds may be saved from destruction. This kindness they will more than repay by the help they give in destroying harmful insects and injurious weeds.

If you would cultivate a closer acquaintance with birds, find some sheltered spot near your home and establish a feeding place that will attract them. This can be done by scattering on the ground chaff, millet, or any seed the birds like. Such birds as the woodpecker, nuthatch, and chickadee may be tempted with pieces of suet, or bones to which bits of meat, fat, or marrow are attached. These should be hung within easy reach of the birds, but must be

securely fastened to prevent their being carried away. If this work is commenced in the early fall, the birds will soon form the habit of coming as daily visitors, and will do their part to aid you in becoming acquainted with the winter ways of birds.

THE ROBIN

A bird came down the walk :
He did n't know I saw ;
He bit an angleworm in halves
And ate the fellow raw.

And then he drank a dew
From a convenient grass,
And then hopped sideways to the wall
To let a beetle pass.

EMILY DICKINSON, " In the Garden "

The name Robin, or Robin Redbreast, was first given to a bird found in England. When the early English settlers in this country saw a bird that resembled the home bird in color, they immediately gave it the same name. The American robin is nearly twice the size of the European bird, and the red on the breast is of a different shade. In the island of Jamaica the name " robin " is given to a small crimson-throated kingfisher, while in British Guiana there is a ground starling that has received this name on account of the color of its breast. The robin belongs to the thrush family and is perhaps the best known of the song birds, because found in such large numbers in nearly every part of North America.

One peculiarity of the robin is his habit of singing at all seasons of the year except during the molting season, or when there is a heavy frost on the ground. All birds are fond of bathing, but the robin has the habit of taking his bath in the evening just before going to bed, after most of the other birds have gone to roost.

The nest that he builds is a clumsy affair made of coarse grass, leaves, rootlets, and the like, held together by a plaster of mud and fine grass on the inside. If the nest is in an exposed place, the mother bird will sometimes protect her young during a storm by standing in the nest with her wings outstretched to serve as an umbrella.

Most of the robins spend the winter in the South. Those that winter in the North are the young that are not strong enough to take the long trip. They usually migrate in flocks, sometimes as many as five hundred being seen together. They fly farther north than any of the other thrushes, and often at a considerable height above the ground. When the robin first arrives in the spring, he feeds on the larvæ of the fly and the grub of the cutworm, which he finds in the ground. Then as the season advances and insects become more plentiful, he eats nothing else. As the food of the young consists principally of insects, and more than one brood is raised each season, the number of insects destroyed by a single pair of robins must be very great. Realizing the beneficial work of the robin in preserving all forms of plant life, we should work to protect him, during the winter season in the South, from the hunter who seeks him either for his feathers or, under another name, for the market.

THE CROW

The "Caw!" "caw!" of the crow is as familiar a note to our ears as the robin's well-known "Cheer up!" "cheer up!" His size, color, and sharp note all serve to make him a conspicuous bird. He is so well known, indeed, that he is frequently referred to as a standard in making certain comparisons, such as "as black as a crow," "as the crow flies," "as sharp as a crow." Like the robin, the crow is found in nearly all parts of the United States,

but in the summer time he goes farther north than the robin, even as far as the "fur countries," while in winter he goes as far south as Mexico. A scarcity of food is the principal reason for his migrating. The crows that remain in the North during the winter are probably those that summer farther north, or those that have found places where there is an abundance of refuse upon which they can feed. They frequently spend the winter along the sea-coast of the southeastern states, where the tides leave them plenty of food, and the ground is not covered with snow, as it is in the interior.

Crows are clannish in their habits and, except during the breeding season, live together in great flocks. During the winter they have the habit of assembling at night at a common roosting place. A pine grove is the place usually chosen. Several of these roosts are known to be occupied by from fifty thousand to three hundred thousand crows each. Perhaps it is fear of their enemies—the great horned owl, hawks, raccoons, and the fox—that leads them to seek the protection that is found in numbers.

No one loves the crow, because of the harm he is supposed to do to crops. In the year 1749 the people in some of the northeastern states were convinced that the crows were spoiling their crops, so the farmers tried to destroy them, and as a result the crops were a complete loss because of the injurious work of the insects that the crow would naturally have destroyed. It is claimed that the crow pulls up sprouted corn, injures corn when it is in the milk, destroys cultivated fruits, feeds on the eggs and young of poultry and wild birds, distributes the seeds of poisonous plants, and eats large numbers of frogs and toads. Sometimes when he is suspected of eating corn, he is merely hunting the white grub of the May beetle and cutworms. He is the natural enemy of the gypsy moth, the brown-tail moth, and many other injurious

insects. He is also the natural enemy of the robin and the blue-jay, because he destroys their eggs and young birds, and in this way seriously checks the increase of the robin.

It is believed by those who have made a study of the subject, that if the farmer would tar the corn seed before planting it, or occasionally scatter some soaked seed about the borders of the corn-field, or plant the seed deep, — three or four inches, — or surround the cornfield with something that would frighten away the crows, he would in time discover from the abundance of his corn crop that the much-abused crow was a friend instead of an enemy.

THE ENGLISH SPARROW

Our largest family of birds, the sparrow, contains more than five hundred species. Of these over thirty varieties live in the eastern part of the United States. The English sparrow is the most widely known, because he not only outnumbers all the other members of his own family, but all other species of birds, either of the sea or land. The fox sparrow is the largest, and the chipping sparrow the smallest, of those that are common. All sparrows have feathers of a neutral color, and while many of them have no song, some have very musical voices and are counted among our choicest song birds.

A little over fifty years ago the cankerworm and other injurious insects that feed on leaves appeared in such great numbers as to threaten the destruction of all trees. After many attempts to destroy them had failed, it was suggested that if the English sparrow, which fed on these worms, could be introduced into this country they might be the means of saving the trees. Thus it happened that in the year 1850 eight pairs of English sparrows were brought to Brooklyn, New York. But these birds did not live, and two years later a larger number were brought over to New York, where they

were kept in confinement until the spring of 1853. They did so well that many more were imported from England and Germany during the next twenty years. The largest number ever liberated at one time was in Philadelphia, where one thousand birds were set free. These birds were at first sent only to our large Eastern cities, but when they had become accustomed to their new surroundings, and it was known that they would thrive in this country, they were carried to towns and cities farther inland.

They have shown a wonderful capacity for adapting themselves to all conditions of life, and are just as much at home in the scorching South as they are in the cold regions of the extreme Northwest. Since it was believed that in the sparrow had been found the natural enemy of the insects that threatened the trees, they were everywhere looked upon with affection and tenderly guarded from harm. In some states this care went so far that special laws were passed for their protection. After the sparrows had become firmly established in this country, people began to realize that they were not proving helpful. Instead of destroying the insects and thus saving the trees, they had developed a great fondness for other kinds of food, and were not only doing great harm to many kinds of plants but had driven away the more common song birds. They had in fact taken possession of the country.

Since their introduction into the city of Boston two efforts have been made to check their too rapid increase. Once Nature sent the great Northern shrike to destroy them, but the city authorities, not understanding the true meaning of the presence of the strange bird, hired men to go to the Common and shoot it. At a later date many people were so disturbed by the noise and litter made by the sparrows that they made war upon them and sought to drive them away by destroying their nests. After thousands of nests had been destroyed, public attention was called to the fact by the great

outcry of a certain newspaper. The work had to stop, because the general public could not understand the value of this wholesale destruction of bird homes.

The value of the English sparrow is a question for serious thought. Personally he is not a handsome bird, he is not a musician, and there is not much in him as a "pie dish," while the material used in nest building, consisting of all sorts of rubbish, disfigures any place chosen for a home. The sparrow is said to destroy, either for food or for pleasure, the buds and blossoms of a great variety of fruit, shade, and ornamental trees. This they do in the spring, and often as a result the crop is entirely destroyed. They frequently attack fruit when it is maturing, and are specially destructive to green peas, first attacking the blossom and then the pod. They also attack growing grains. While it is true that the adult birds eat a few insects, they eat fewer, in proportion to the rest of their food, than any of our small native birds. The young, while in the nest, are fed largely on insects, and since two and sometimes three broods are raised in a season, a large number of insects must be destroyed by them.

As to their relation to other birds, Mr. Edward H. Forbush says, "The English sparrow is the only one of the small birds that has repeatedly been seen to destroy the nests of other birds, break their eggs, kill their young, mob them, and drive them away from their homes."

If all the English sparrows were exterminated because of the harm they do, is there any other bird that would take their place in the crowded cities? There they live and thrive without the shelter of green-leaved trees, while they feast on the refuse they pick up in the crowded streets. Will any of our native birds do this? Would the great city not seem a lonely place without the sparrow? In many cities the sparrow is the only bird with which the children

of the slums are acquainted, and for this reason, if for no other, we wonder if the city can afford to exterminate this bird.

THE OSTRICH

Of all the birds that inhabit the earth there is none that can equal the ostrich in size, value, and ugliness. It is only when the chick first comes from the egg that it can make any claim to being attractive looking. Then it has a round, plump body, and its long neck is covered with a soft down matching in color the rough, wiry, hairlike feathers on the body. The latter are soon replaced by a growth of "chicken feathers," which at the end of the third year become the valuable feathers of commerce.

When the bird is about a year old it is plucked for the first time, but the feathers are stiff and narrow, with pointed tips. By the time the bird is three years old the feathers have acquired their full width and softness and are plucked once every year. During the first two years all birds are covered with a dingy gray and black plumage, and it is difficult to distinguish the male from the female bird. At the end of five years the birds have attained their full growth.

The plumage of the female is a soft gray, that of the male is a beautiful glossy black with white wing and tail feathers. The twenty-five white feathers found in each wing of the male are the most valuable. When the birds are plucked, the feathers on the wings are cut off with shears before the quills are ripe or ready to drop, in order to prevent the tips from being spoiled. The stumps of the quills are left to ripen, which requires from two to three months, and then they can be pulled out without hurting the bird or injuring the growth of new feathers.

The long, strong legs and thighs of the ostrich, which are destitute of feathers, are covered with a coarse, blue-gray skin that makes

them appear very ugly. They are the only part of the body that is fleshy, for when stripped of its plumage the rest of the ostrich seems to be nothing but skin and bones. The neck, often three feet in length, is bare except for scanty tufts of down, while the small, flat head is quite bald. These birds would be altogether ugly were it not for their beautiful plumage and their big, soft, dark eyes.

The ostrich requires a great deal of water and much green food. Not having any teeth, he must eat something hard and coarse, like pebbles, to aid his digestion. This accounts for his fondness for bones, bits of china, or glass. He has been known to swallow a lighted pipe and a corkscrew without injury to himself. The old saying that the ostrich is so stupid that he thought to hide his body by hiding his head in the sand probably arose from the fact that he spends much time with his head buried in the sand hunting for pebbles.

During the breeding season the male ostrich becomes very savage, and is ready to fight any one who disturbs him. When angry he is said to utter a note that resembles the distant roar of a lion. Advancing toward his enemy, he challenges him to fight by sitting down and moving his head from side to side. This challenge he may repeat several times as he advances. The blow he is able to give with his foot is extremely dangerous, as the toes are armed with claws that cut like knives. Owing to the peculiar way in which the legs are jointed, the ostrich gives a forward, downward kick instead of a backward one like the horse. He is more afraid of a dog than he is of a man, because his kick can do no damage to anything less than three feet high, which insures the safety of the dog and leaves him free to worry the ostrich.

When the breeding season arrives both birds work to prepare the nest. This consists of a round hole about four feet in diameter and one foot deep, dug in the sand. When this is completed



AFRICAN OSTRICH

the hen will lay one egg a day until she has fifteen or twenty, according to the number she knows she can cover. Then during the forty days required for hatching, the two birds will take turns sitting on the nest. The female sits from nine in the morning until four in the afternoon, at which time the male takes the nest and sits through the night. This routine is probably due to the fact that the feathers of the female are less noticeable during the day, as they closely resemble the sand, while the black feathers of the male are not easily seen at night. Every morning and evening the nest is left uncovered for about fifteen minutes to allow the eggs to cool. Before leaving them, the hen carefully places a pinch of sand on the top of each in order that the heat of the sun may not injure it. The hen has no voice, and the only way in which she can call her chicks is by rattling her wings.

The ostrich is a long-lived bird, many reaching the age of forty or fifty years, while a few live to be much older. But no matter to what age they live, the quality of their feathers remains the same as when they were young. One reason why more of them do not live to a good old age is the frequency with which they break bones in their legs. Such an injury makes it necessary to kill the bird at once. Many a broken bone is the result of their habit of "waltzing" when first turned out of the kraal on a pleasant morning. When first released they will stand erect, with wings outstretched, and then, whirling madly, go spinning over the ground until they become so dizzy that they tumble down, often snapping a bone as they fall. Another thing that frequently results in a broken leg is their habit of fighting. When once the fight begins they grow so savage that they deal terrific blows. If one happens to strike the leg, the frail bone breaks and the death of the bird inevitably follows.

The ostrich is a native of Africa. The Barbary ostrich, found in the North, is considered more valuable than those raised in Cape

Colony. Ever since they were first discovered, these birds have been sought for their beautiful plumage. In early times it was thought necessary to kill them in order to secure their feathers. When it became evident that this was causing the destruction of the species, man began searching for some way of securing the feathers without destroying the bird. It was an Englishman living in South Africa who first succeeded in trapping a bird and proving that it was possible to raise them in confinement.

At the present time there are between four and five hundred thousand birds on ostrich farms in South Africa. About five million dollars' worth of African ostrich feathers, in their raw state, are sold every year in London, and nearly one million five hundred thousand dollars' worth are sold in New York. About twenty-five years ago the experiment was made of purchasing fifty-two birds in South Africa and carrying them to California, to see if they could be raised in this country. This experiment has proved successful, for although a number of birds died on the trip, the greater part of them were landed in safety, and at the present time more than two hundred can be seen at the ostrich farm in Pasadena, California. One or two other farms have been successfully started in California, and the demand for the feathers greatly exceeds the supply.

THE FLAMINGO

Although the flamingo lives in the warm regions of both hemispheres, he is found in greatest numbers among the Bahama Islands. There he is able to find an abundance of the small spiral shellfish on which he feeds, and has little to fear from harmful animals. Flamingoes are the largest of the brilliantly colored birds. Until a few years ago little was known of their peculiar habits, as no one had ever watched them during their breeding season. At nesting time they collect in such vast numbers that

their breeding ground is sometimes called "Flamingo City." In building their nests, which are of mud, they take care to build them high enough to protect the eggs from any sudden rise of water. In some places it is necessary to build them only eight inches high, in others they must be at least thirteen inches above



FLAMINGOES

the ground. The bottom of the nest, which is often fourteen inches in diameter, is nearly a third wider than the top. In the top is a depression about an inch in depth which forms the real nest, and is without any lining and never contains more than a single egg. If the female occupies the nest during the day, she leaves it at nightfall in order to feed, and the male, which has been feeding during the day, takes her place for the night.

One of the marked peculiarities of the old birds is the shape of their bills. When the chick is first hatched his bill is short and straight, but when he is about three weeks old and has commenced collecting his own food, the bill shows signs of curving. This is due to his peculiar manner of feeding. He twists his long neck until the upper half of his bill rests on the ground under water. After filling his mouth with the soft material found on the sea bottom he is able, by the rapid movement of the upper half of his bill, to force little streams of water through his mouth to wash out the sand and mud surrounding the shells he has collected. Sometimes these shells are so buried in the hard mud that the flamingo has to use his feet to dig them out, and the rapid movement of the body, while the head is under water, gives the bird the appearance of performing some strange sort of a bird dance.

When the flamingo sleeps, his neck is twisted and coiled in a strange fashion to enable him to tuck his head under the feathers on his back. In describing the flight of the flamingoes Mr. Frank Chapman says: "They resemble no other bird known. With legs and neck fully outstretched, and with comparatively small wings set halfway between bill and toes, they look as if they might fly backward or forward with equal ease. When hurried they fly with a singular serpentine motion of neck and body, as if crawling in the air."

THE PELICAN

The pelican is another bird whose strangely formed bill makes one wonder as to its use. The brown pelican is found in large numbers along the eastern coast of Florida. Among the many islands to be found in the Indian River there is one known as Pelican Island, because it is the favorite breeding ground of these birds. Their small, rude nests, made of grass and other soft

materials, are usually placed on the sand, though sometimes they are built on the tops of spreading branches of low mangrove trees. In the latter case they are more bulky, being made of sticks and lined with grass.

When the pelican wishes to secure food for his young he flies rapidly, at a height of from thirty to forty feet above the surface



INDIAN AND BROWN PELICANS

of the water, watching all the time for schools of sardines or smelts. When he catches sight of one he suddenly dashes down, diving headlong into the water, with his bill held wide open so that the scooplike pouch acts as a net with which to catch the fish. Rising quickly from the water, he tosses his beak upward to throw the fish down his throat. Returning to his nest, he opens his

bill and the young bird thrusts its head and neck down its parent's throat to get the half-digested fish. Sometimes the pelican gets cheated out of the fish he has caught, for when he is in the act of tossing it down his own throat a white-headed gull may light on his back and, snatching the fish, fly away with a loud "ha-ha" at the trick he has played on the pelican.

Summary. 1.

What characteristics have birds in common with all the animals we have studied? 2. In what two respects do



WHITE PELICAN

From Linville and Kelley's "General Zoölogy"

they differ from all other animals? 3. Of what real value is the bird to man? 4. What will happen if the eggs and young birds are not protected? 5. How will this affect vegetation? 6. Can bird life be protected? How? 7. In what ways are birds of commercial value to man? 8. Which birds are of the greatest value to the greatest number of people? Why?

CHAPTER VIII

REPTILES

SPECIAL STUDY OF THE SNAKE

Turn to the outline of classification (p. 189) and determine to which kingdom and class the snake belongs. See if from your study you can determine two distinguishing characteristics of the



COPPERHEAD SNAKE

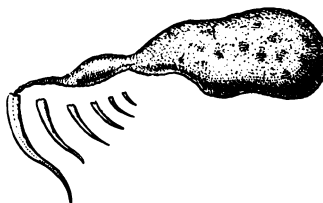
snake. In your notebook make a record of these characteristics under a picture of the snake.

The little green snake, which is perfectly harmless, is the best one to study. It can be kept in a wire-covered cage for several days, while its habits are being observed. Perhaps the cast-off skin of some snake can be secured, so that the scales and scaly plates may be carefully examined.

Observation work. Where does the little green snake live? What color is it? How does this color correspond to the color of its surroundings? Of what special value is this to the snake? What

do you notice about the limbs of the snake? How does it move over the ground? Does the body move up and down or sidewise as it glides along? What is there on the underside of the body that enables it to move in this way? Using your notebook, make a record of the facts you have observed that show the adaptation of the color of the snake to its surroundings; the covering to its habits of moving. If you have the cast-off skin, make an enlarged sketch of the scales, to show the difference between those on the back and those on the underside of the body.

Give the snake an earthworm and watch it eat. What is peculiar about the tongue? Has the snake any teeth? Are they sharp or flat? Which way do they point? Of what value is this in eating? Do you notice anything peculiar about the way the lower jaw works? Examine the eyes. How are they protected? What do you notice about the eye of the cast-off skin, or "slough"? Make a summary of these observations so as to record the facts relating to the adaptation of the mouth and eye to the snake's habits of life.



SKULL OF RATTLESNAKE, SHOWING
POISON FANGS

From Baskett's "Story of the Amphibians
and Reptiles"

Questions for thought. 1. Which is the most common among the harmless varieties of snakes? 2. Are snakes ever found in the water? 3. What fits them to live under water? 4. Which is the largest of all the snakes? 5. Where is it found? 6. How does it

kill its prey? 7. Where is the moccasin found? the copperhead? the rattlesnake? 8. From what does the rattlesnake receive its name? 9. Of what value is the horny rattle?

You may have felt surprised when you discovered what animals belonged to the class of reptiles. If so, the following interesting facts will help you to understand in what respects they are alike and why they are placed in the same class.

THE SNAKE

Among the common forms of animal life the snake alone seems to have won no place in man's affection, and to be thought unworthy of his protection. This may be due to the fact that several species are known to be poisonous; or it may be that we look with suspicion on the seemingly mysterious manner in which they glide over the ground, or shrink from touching their cold bodies. Instead of carelessly destroying any and all snakes, we should learn to understand some of their peculiarities and to distinguish between snakes that are beneficial and those that are dangerous.

From our observations of snakes we learn that their eyes are not protected by eyelids but by a thin, nearly transparent skin. An examination of the cast-off skin will show that in shape and color it is something like the crystal of a watch. The snake has no limbs, and in this respect differs from all other reptiles. Its long, slender body is covered on the upper side with small scales, while on the underside the scales form broad plates which extend across the body. Because its backbone can be moved backward and forward, as well as up and down, the snake is able, with the help of the scaly plates, to crawl by side twists. By this means it moves so rapidly that it appears to glide over the ground as though moved by some mysterious power.

All snakes have teeth, which are sharp, pointed, and fastened in the jaw so that they slant toward the back. They are not used for biting or tearing, but for seizing and pulling the food into the mouth.



MOUTH OF RATTLESNAKE

The poisonous snakes have fewer teeth than the others. In the upper front jaw of the former are two long, hollow teeth known as poison fangs. The hole running through these teeth connects with a poison sac situated just behind the eye. When the jaws are

closed the fangs are folded against the roof of the mouth, but when the jaws are open these fangs spring into place and are ready for use. They are shed about every three months. The new fangs commence to grow before it is time for the old ones to drop out. Just before the old ones are shed the new ones are connected with the poison sac, so that the snake is never without this means of defense. The tongue is long and slender and the tip is forked. This is used chiefly as an organ of touch.

The two halves of the lower jaw are separate and can be moved independently of each other. After seizing his prey the snake loosens his hold upon one side of the jaw and, pushing that side forward as far as possible, drives the teeth into the flesh of his prey. Then drawing that side back, he pushes the other forward. By repeating this movement the food is drawn into the mouth. The lower and upper jaws are fastened together in such a way as to permit the snake to open his mouth wide enough to swallow animals that are frequently much larger around than he is himself. In order to make it easier to swallow their food, nearly all snakes cover it with slime from their own mouths. After a hearty meal they crawl away to some quiet hiding place where they can lie undisturbed until their food is digested.

While the young snake is growing he sheds his skin frequently, but full-grown snakes usually shed theirs twice a year. When it is time to shed, or "slough," the skin, the old skin becomes loosened from the new one that is underneath and splits around the lips. Then the snake crawls through some crack in the rocks or under the low branches of shrubs where there is something rough to catch and hold the old skin while he crawls out of it, leaving it turned wrong side out.

Of the harmless varieties the garter snake is perhaps the most common. The food of this snake consists principally of

earthworms, field mice, toads, and frogs. Since snakes must of necessity destroy many animals that feed on injurious insects, they do a great deal of harm. When cold weather comes they gather in large numbers for their winter sleep, usually choosing some place that is exposed to the sun, so that they can enjoy the heat during the day. At night they hide in the cracks of rocks or in holes in the ground. As soon as it is cold enough for severe frosts they remain below ground all the time.

The cobra, which is found in India and the Malay Peninsula, is considered the most dangerous of poisonous snakes, on account of its size and the quantity of poison it secretes. The python, another large variety, is found in Asia and Africa. The boa constrictor is the largest snake found in tropical America. The boas seize their prey and, coiling their powerful necks about it, are able to squeeze all life out of it. Then, covering it with slime, they swallow it whole. The little coral snake, the moccasin, and the copperhead, all poisonous snakes, are peculiar to the South, while the rattlesnake is found in regions not thickly settled in nearly all parts of the United States.

THE TURTLE AND TORTOISE

If you are wondering why the turtle is classed among the reptiles, you will be interested in examining the skeleton of one of these animals. You will find that the shell is formed of plates fastened to the ribs and vertebræ, or, in other words, the usual order of arrangement is reversed and the skeleton is worn on the outside instead of the inside — all of which goes to prove that the turtle is a true vertebrate and is covered with scaly plates like all true reptiles. Certain members of this family spend most of their time in the sea, and are called turtles to distinguish them from the tortoise, or those that live on land or in fresh water. The true turtle

has his hind feet webbed and is an excellent swimmer, while those that spend their time on land have their toes armed with claws. Turtles that spend most of their time under water not only swallow their food beneath the water, but are unable to eat when on land.



YELLOW-BELLIED TERRAPIN

The shell is large enough to permit the turtle to draw in his tail, legs, and head, and thus hide all the soft parts of his body within the hard covering. One species, known as the box tortoise, has a shell, the lower part of which is hinged in such a way that the two parts can be brought so close together that it is difficult to pry them open.

There are several varieties of turtles whose flesh is eaten, but which have no market value outside of the place where they are caught. The terrapin, which is found near the borders of ponds, brooks, and some rivers, and in the salt marshes of the eastern coast, is extensively used as an article of food in all parts of the country. The hawksbill, the smallest of the sea turtles, is distinguished from other turtles by the loosely overlapping shields that form the covering of the upper part of the shell. They consist of a clear, horny substance which, when taken from the shell, forms what is known as "tortoise shell."

In certain tropical countries the natives have a peculiar method of capturing turtles. They first catch the "sucking fish" (so called from the sucker-like attachment on the top of its head), to which they attach a strong string. They then set this fish free in waters where turtles are known to be. The fish soon attaches itself by the sucker to the underside of the turtle's shell, and takes such a firm hold that the turtle can be drawn gently to the surface by means of the string fastened to the fish.

CROCODILES AND ALLIGATORS

There was a time in the early history of the Egyptians when they worshiped many gods and believed that certain animals were closely connected with these gods. The only persons who understood the true meaning of the relation that existed between the gods and animals were the priests, and they purposely surrounded all forms of worship with mystery, until mystery became an important part of every religious ceremony. The crocodile not only was considered sacred, but was believed to be the symbol of mystery, for he was thought to have no tongue. This strange idea grew out of the fact that the crocodile, instead of having a well-developed tongue, has within its mouth an unformed mass of flesh without

any tip. This is sufficiently large to act as a valve to cover the throat, so as to prevent anything but food from going into the stomach while the crocodile is pursuing his prey under water.

The crocodile is not as stout or heavy an animal as the alligator, and there is a marked difference in the shape of the heads of the two. The head of the crocodile is narrow and pointed, while the alligator has a broad head with a blunt, rounded snout. The lower

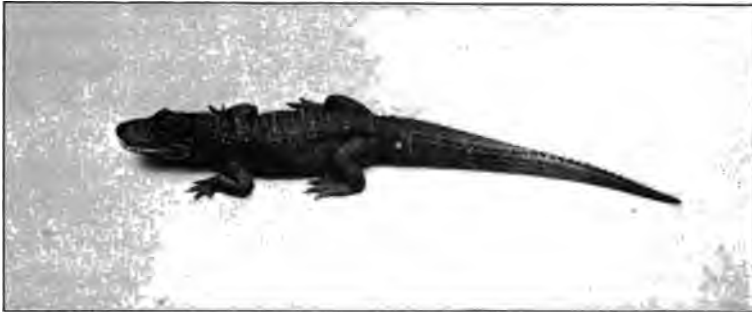


CROCODILE

teeth of the crocodile fit into notches in the sides of the upper jaw, while those of the alligator shut inside his upper teeth and fit into holes in the upper jaw. In the lower jaw of the crocodile there are usually two teeth that pierce the upper jaw in such a way that the white, glistening points show above the dark skin of the snout. The jaw of the alligator, instead of being made of solid bone, which, on account of its great length, could easily be broken, is formed of sections of bone fastened together like the springs of a crossbow. This long jaw contains about eighty sharp, pointed teeth. The

curious arrangement of a long tooth alternating with a short tooth throughout the entire set makes the teeth look like the fangs of some carnivorous animal. This peculiarity in the appearance of the teeth is increased by the fact that there are no lips to hide them, and therefore they are always uncovered, giving the animal an angry look. The alligators shed their teeth every year in the early spring, at which time they are small and sharp, while in the fall they are large and round.

In the spring, when it is time to make a nest, the female alligator selects a dry place in some swamp, where she builds a little



ALLIGATOR

mound of dried leaves, pieces of sticks, and any soft material she can find. In the center of the nest she lays from twenty to forty eggs, which are white and about the size of a hen's egg. As soon as the eggs hatch the little ones hide, and are seldom seen unless they are with their mother. They like to ride on their mother's back and watch her gather food. The young alligators have many enemies, for large cranes, certain kinds of fish, and the bull alligator consider them good food. When they are quite small, and danger threatens, they will sometimes hide in their mother's throat if there is no other hiding place.

The alligator feeds principally upon fish, birds, and mammals. He has such a thick, short neck that he is able to move his head but slightly. After he has located his prey, he bends his entire body in the form of a bow, bringing his tail toward his head with such force as to knock down his prey and sweep it near enough his mouth to be easily secured. Then with his powerful teeth he can with ease crush bones as large as those in a man's leg. In hunting these animals a man is comparatively safe if he keeps out of the way of the powerful tail. In many parts of the South the eggs of the alligator are eaten, and as each nest contains a large number, search for the eggs gives employment to many individuals. The alligator has been eagerly sought for his skin, which has been extensively used as leather for the manufacture of fancy articles.

The crocodile is found in every continent except Europe. The dangerous man-eating crocodile lives in India and Africa. Those found in the Ganges River sometimes grow to be fifteen feet in length. Although frequently found in Mexico, it was not until the year 1875 that a true crocodile was discovered in the United States. At that time one was captured in the extreme southern part of Florida. The alligator lives in the rivers and swamps of the low coastal region from North Carolina, throughout Florida, and westward to the Rio Grande in Texas.

Summary. 1. What distinguishing characteristics are common to the snake, the turtle, and the crocodile? 2. How does the snake differ from other reptiles? the turtle? 3. How does the crocodile differ from the alligator? 4. Which of the reptiles are useful to man? 5. In what ways are they useful? 6. Which reptiles are dangerous? 7. Which ones are harmless?

CHAPTER IX

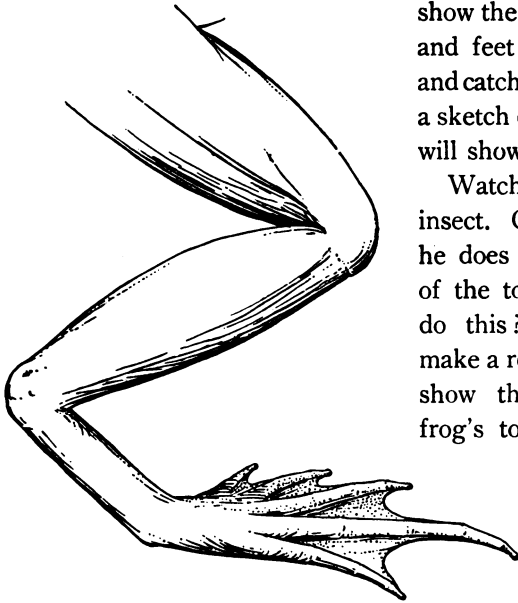
AMPHIBIANS

SPECIAL STUDY OF THE FROG

Turn to the outline of classification (p. 189) and see where the frog belongs. What are the young of all amphibians called? From your study try to give the three distinguishing characteristics of the frog. Under a sketch or picture of the frog make a record of these characteristics.

Observation work. Where are the eggs of the frog found? What color are they? How does this color correspond with the color of their surroundings? Is this of any special value? Note the color of the tadpole. Does the color serve any particular purpose? Where do tadpoles live? How must they breathe? Watch the very young tadpoles and see if you can detect the gills. Where do frogs live? How do they breathe? Think of one change that must take place in the tadpole before it can leave the water. Make a summary of these observations and record the facts that show the adaptation of the frog to its surroundings. Illustrate this with sketches of the mass of eggs, a single egg, and the tadpole.

Compare the fore and hind legs of the frog. What differences do you note? Examine the toes on their fore and hind feet for points of difference. What do their long hind legs enable them to do? Of what special value is this to the frog? Does the frog need webbed feet? Watch and learn how he uses his forefeet, or hands, as they are sometimes called. Make a summary of the facts that



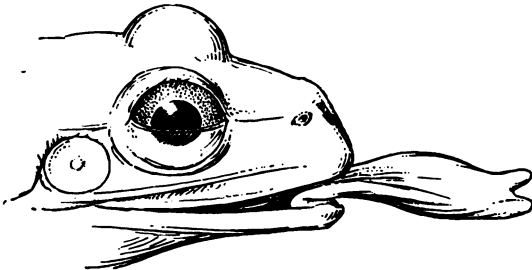
FROG'S HIND LEG

show the adaptation of the legs and feet to habits of moving and catching prey. Illustrate by a sketch of the hind leg, which will show the webbed toes.

Watch the frog catch an insect. Can you discover how he does it? What peculiarity of the tongue enables him to do this? In your notebook make a record of the facts that show the adaptation of the frog's tongue to his habit of eating. Make a list of animals that are similar to the frog and illustrate with pictures as far as possible.

Geographical distribution. Can frogs and toads live in very dry countries? Why? Can they live in places where it is very cold? Why? Then what two facts are most important in determining where such animals can live?

Questions for thought. 1. In what respects are frogs and toads



FROG'S HEAD, SHOWING HOW THE TONGUE IS FASTENED

alike? 2. In what do they differ? 3. Of what value is the frog to man? the toad? 4. Which do you consider the most valuable? Why?

After collecting frog's and toad's eggs, and enjoying the pleasure of watching them develop, you will be interested in reading the account of how they shed their skin, how they drink, where and how they pass the cold winter months, and their value to man.

THE FROG

If you would learn to enjoy the first awakening of spring, you should listen for the first note of the frog, keep a record of the date when you hear the first call, and try to distinguish the differences in the notes of the different frogs and the trills of the male toad. Frogs and toads differ in several respects, as you can easily discover. The frog has a smooth skin, the toad's is rough and warty; the frog's fingers and toes are more fully webbed than those of the toad; the frog has small teeth in the upper jaw, the toad has no teeth; the eggs of the frog are laid in an irregular jelly-like mass, while the toad's eggs are laid singly and form a rope or string. In spite of these differences the frog and toad resemble each other in some of their peculiar habits. They both absorb water through the skin instead of taking it through the mouth. They shed the skin in a similar manner, and both hibernate during the winter months. All frogs do not hibernate in the same way. The wood frog sleeps under leaves and mossy logs, the green frog hides in the moss or makes a shallow burrow in the bank of some pond, while the bullfrog, the largest of all frogs, buries himself in the mud at the bottom of a large pond or lake.

When under water or while hibernating during the winter, the frog does not breathe air with the lungs but depends wholly upon the air taken in through the skin. For this reason the skin must

be kept moist. If it becomes dry, the frog cannot get air enough and soon dies. For the same reason the frog can never travel very far from water, for if the air is dry he has to moisten his



DEVELOPMENT OF THE FROG

skin by occasional plunges into the water. The beautiful green, brown, and yellow with which the back of the frog is marked makes him resemble the weeds, and this serves as a protection when he lies among them. If startled by any unexpected sight

or sound, he plunges to the bottom of the pond. His long hind legs are of great assistance to him when escaping from enemies.

The pickerel frog lives out of the water more than he does in it, while the bullfrog seldom leaves the water for any length of



BULLFROG

time. Those frogs that spend only a part of their time in the water eat fish, tadpoles, small frogs, water insects, land insects, and earthworms. The bullfrog gets all his food from the water. On account of the bullfrog's long, strong hind legs and the large webs between the long toes he is a powerful swimmer. When he

dives, he forces out the air that is in his lungs and closes his nostrils. The air that is thus driven off rises to the surface in great bubbles. Being able to take in the air through the skin, he can remain under water for a long time. When swimming under water he closes his eyes by lowering them in their sockets. This protects the eye from injury but makes it necessary for him to stop frequently and open them to see where he is.

It is only within a comparatively short time that "frog's legs" have been used as an article of food. Among the frogs sought for market is the "bellow," found in the swamps of Louisiana, which grows to four pounds in weight and is considered the choicest food. Next come the Potomac and New York frogs, both of which are large and have a fine flavor. In the Northwest many persons make a business of collecting frog's legs for market. In the state of Minnesota alone, as many as six million frogs are killed yearly for market purposes.

So great is the demand for frogs that hatcheries have been established in several places. In Massachusetts there is one farm of ten acres devoted to this industry. A stream of running water that flows through this farm has been used to make a series of artificial ponds connected by locks. The walls and bottoms of these ponds are made of cement to prevent the frogs from escaping. The eggs are hatched in one of the smallest ponds. When the tadpoles develop they are transferred to a larger pond, and when they are about one year old they are placed in a still larger one. Then during the second year they are transferred to one of the largest. It takes about two years for the frog to grow large enough to be ready for market. When first hatched the tadpoles feed upon a substance found outside of the eggs. Later they eat the lower forms of animal life that can be found in abundance in all natural ponds. In such a hatchery as just described, from

twenty thousand to forty thousand frogs are raised in a year. These are sold to hotels and markets for food, and to medical schools for use in the study of natural history.

THE TOAD

While the toad lacks all the beauty of color and marking that distinguishes the frog, his color, just matching that of the soil in which he lives, serves to protect him from snakes and birds of prey, and also conceals him from the insects he wishes to catch. His skin is rough and warty, the rough places being formed by the poison glands in the skin. These glands secrete a whitish fluid which the toad discharges when attacked. This fluid is poisonous to small animals if it gets into their blood, and it will cause great discomfort if it touches either the eye or the mouth of carnivorous animals like the dog. For this reason there are very few animals that care to interfere with the toad. If the toad-tadpole is disturbed, it also discharges a fluid that often injures the tadpoles of frogs or salamanders if they are in the same water. Sometimes when the toad is caught in the hand he will fill his body with air, making it so round that it is difficult to hold. Another peculiar means of defense consists in "playing dead," by lying on the back without moving or seeming to breathe.

After selecting a place that suits him, the toad will frequently remain there for several years, because it is very difficult for him to travel any distance over rough ground. During the day he hides under a stone or in a damp, shady place, coming out at night to search for food, and returning to his hiding place after securing enough to eat. When he returns to his hole he backs in and rests with his nose and bright eyes showing just within the opening. If he is frightened, he will force his way backward until the earth falls in and buries him.

The toad selects a moist place for his home because he cannot drink water in the usual way. All the water he gets he absorbs through the skin. It is said that he "soaks in" water, and if he gets plenty of moisture he will keep fat and happy even though he does not have all the food he likes. The toad feeds upon slugs, snails, earthworms, and many kinds of insects that are injurious to plants, but all his food must be taken alive. His tongue, which is



COMMON TOAD

covered with a sticky substance, is fastened at the front end just back of the lower lip. He catches insects as they fly past him, by suddenly throwing out his tongue in such a way that the sticky substance catches and holds them as a piece of flypaper would. When eating an earthworm he seizes the end of it in his jaws and uses his forefeet to stuff it into his mouth.

The outer, horny skin of the toad is not very elastic, so the young toad sheds it every few weeks in order to have a covering large

enough to fit his rapidly growing body. The older toads shed their skin at least four times a year. Miss Mary C. Dickerson says: "The skin is shed in one piece and is swallowed. It requires about five minutes or less time than this for the shedding. The outer skin, over the whole external surface of the toad, becomes naturally free or loose from the skin underneath. This splits along the middle of the underside of the body and across the chest from arm to arm. Then the toad begins the process by which the loosened skin is drawn into the corners of the mouth. In fact, throughout the molting it is the mouth that does the work of getting off the skin. This consists of repeatedly opening the mouth wide and expanding the body so that the loosened skin is forced slightly forward, then shutting the mouth. By this method the skin is gradually sucked and dragged into the mouth at the angles of the jaw. The toad also uses the front feet as hands to help him get the skin down from over the eyes. The covering from the hind legs is next removed, then the front arms are slipped from the old skin, the skin of the hands and toes being usually turned wrong side out in the process. The last part of the skin to be shed is that on the throat and arms."

The toad is called a cold-blooded animal; that is, his blood is about the same temperature as that of the surrounding air. For this reason he is greatly influenced by the extremes of heat and cold. When cold weather comes his blood flows more slowly and it is difficult for him to breathe. This makes him feel stupid and sleepy. Warned by this feeling, he knows it is time to find a safe hiding place for the winter. The place in which he makes his burrow must be moist but not wet. If it is too dry, he will die before spring. The depth to which he digs will depend upon the place chosen. If it is under a log or stone, he will not have to go as deep as when an open field or garden is chosen. Mr. Simon H. Gage thus

describes the way the toad works: "It will be found that the toad digs backwards, not forwards. He digs with his hind legs and body, and pushes himself backward into the hole with his fore legs. The earth caves in as the animal backs into the ground, so that no sign is left on the outside. Once in far enough to escape the freezing and thawing of winter, the toad moves around till there is a little chamber slightly larger than his body; then he draws his legs up close, shuts his eyes, puts his head down between or on his hands, and goes to sleep and sleeps for five months or more." Several toads are sometimes found together in one hiding place.

Toads live to a good old age. The story is told of one that lived to be thirty-six years old and then was killed by accident. The distribution of toads depends upon the temperature and moisture. They cannot live either in the far north or in high altitudes on account of the torpor produced by the cold. Their home must be where there is an abundance of moisture because of their peculiar habit of taking water through the skin. The toad is of so much importance to the farmer and the gardener that he should be encouraged to make his home wherever there are growing plants. It costs nothing to keep him, and there is no form of insect life that he will refuse to eat. Careful study has shown that a single good-sized toad will eat as many as ten thousand insects in a season.

THE TREE TOAD

Tadpoles of the tree toad are usually found most abundant in waters of small, still, shadowy ponds, near large trees. The eggs, which are surrounded by a thin jelly-like substance, are attached singly or in groups along the grasses which grow up and rest on the water. The tree toad has soft pads on his toes, which act like suckers and help him to cling when climbing. He has the power to change his color to simulate different shades of gray and

green, which makes it possible for him to resemble the bark of the different trees on which he hides.

During the day these toads remain hidden on the rough bark of trees, their hands and feet, which are evidently very sensitive, carefully folded under the body in such a manner that only the outer edge touches the surface on which they rest. When in this position they so closely resemble a bit of moss-covered bark that it is difficult for their enemies to discover them. In addition to this protective color, the tree toad has the power to send out an acid secretion when he is dis-



TREE TOAD

turbed. This makes him so unpleasant to the taste that the birds, which might otherwise destroy him, leave him undisturbed.

Though the shrill notes of the tree toad are not musical, they ring with a message of cheer, for they are among the first sounds to proclaim the awakening of life in the spring.

THE NEWT

It is just possible that your collection of toad's and frog's eggs will contain a mass of newt's eggs. Unless it is fastened to a twig or leaf it may not attract your attention until it is time for the eggs to hatch. Then you will discover that the tadpole, even before it leaves the egg, has a longer body and larger gills than the frog tadpole. The changes that take place in the newt tadpole are not

so noticeable as those you will see in the tadpole of the toad or frog, because the newt never loses its tail, and requires several years to complete its full growth. If the newt tadpole is given plenty of fresh animal food, it may be kept for several months, or until you are familiar with the tadpole stage in its life history.

Summary. 1. What distinguishing characteristics have amphibians in common with reptiles? 2. How do they differ from reptiles? 3. In what respects does the frog differ from the toad? 4. Why cannot frogs and toads live in very cold regions? in high mountainous regions? 5. Why can they not live in dry countries? 6. Which is of greater value to man, the frog or the toad? Why? 7. Which has a commercial value to man? Why?

A STUDY OF INVERTEBRATES

CHAPTER X

INSECTS

Make a list of all the invertebrates you know. Examine the ant, fly, cricket, grasshopper, and earthworm. In what respects are they all alike? In what respects do they differ? In your notebook make a record of the distinguishing characteristics you discover, under the headings Insects, Worms. Group all the invertebrates under these two divisions :

Insects	Worms
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SPECIAL STUDY OF INSECTS

Material. Flies and ants under a glass with a bit of moistened sugar ; crickets and grasshoppers in a glass jar with a sod of grass.

Observation work. Examine one of these insects and note the number of parts into which the body is divided. Can you find the same number of divisions in the bodies of the others? Make a sketch of some insects to show the parts of the body. Use the scientific names, head, thorax, and abdomen, and describe these parts.

To which part of the body are the legs attached? How many pairs of legs are there? Do all insects have the same number of legs? Do all have jointed legs? Do all have the same number of joints in their legs? Is there anything else attached to the thorax?

Examine other insects to note whether all have wings. Examine the fly or ant to note what is attached to the head. Of what are the antennæ formed? Do all insects have antennæ? Of what value are they to the insect? In your notebook make a record of the facts that show the distinguishing characteristic of insects.

Watch for bees, wasps, flies, grasshoppers, and other insects. Where are they often seen? Why are they in the air? By what means are they able to move through the air? Examine as many insects as you can, to see if all have wings. Do all have the same number of wings? Do all have the same kind of wings? What differences do you notice? Where do bees, flies, and butterflies spend most of their time? Do their wings fold? Why? Where do beetles, crickets, and grasshoppers spend a part of their time? Do they need wings that fold? Why? In your notebook write a summary that will show the adaptation of the wings of insects to their habits of life.

Where are insects found besides in the air? What enables them to walk and climb? Examine the feet of the fly to note how it is fitted for walking over polished surfaces, and also over rough surfaces. Examine the feet of other insects to find how they are fitted for clinging and climbing. What do you notice on either side of the fly's head? Examine other insects to note whether they all have both simple and compound eyes.¹ In your notebook make a summary of the facts that show the adaptation of the feet and wings of insects to their habits of moving, and the adaptation of their eyes to their habits of life. Illustrate as far as possible with sketches.

Watch the ant, cricket, and grasshopper to note what they eat, how they eat, and for what their mouth parts are fitted. What is

¹ The teacher must explain the peculiar structure of the compound eye and show by a sketch where to look for the simple eyes.

the food of the bee, fly, butterfly? For what must their mouth parts be fitted? Make a summary in your notebook that will show the adaptation of the mouth parts to their habits of eating.



WOOLLY-BEAR

From Miss Dickerson's "Moths and Butterflies"

All insects have enemies. Can you discover what they are? Upon what do the fly, butterfly, and dragon-fly depend for protection? What do many water insects do when attacked by an enemy? How do crickets and grasshoppers escape being caught?

What weapon of defense have bees and wasps? Watch plant lice and walking-sticks and consider the value of their color. What is peculiar about the way the cankerworm travels? What does it resemble when in this position? Is this a protection?

STAGES IN INSECT LIFE

Material. Caterpillars found on the leaves of the parsley and nasturtium, and the woolly-bear caterpillar; chrysalides and cocoons from trees, fences, decayed wood, and similar places.



ASTERIAS CATERPILLAR

From Miss Dickerson's "Moths and Butterflies"

Observation work. Watch the caterpillars eat, and note the changes that take place as they grow. From what do caterpillars come? Watch each caterpillar prepare for the next change when fully grown. In your notebook make a record of the changes noted in the life of the woolly-bear and the parsley or asterias caterpillar. Illustrate with sketches.

Compare as many different kinds of cocoons as possible to note their size and general appearance, of what the covering consists, its

thickness, and how attached. What does this covering protect? Compare the chrysalis with the cocoon to note the difference in shape, color, texture of covering, uses. Open a cocoon to see what it contains. (This can be done carefully and sealed up again without injuring the pupa.) What stage in the life of the insect has been reached when a cocoon or chrysalis is made? What will come from the cocoon and chrysalis? When will this take place? In your notebook make a record of the distinguishing characteristics of each of the four stages in the life of an insect.

PREPARATION OF INSECTS FOR WINTER

The greater number of flies, bees, wasps, and other similar insects are killed by the winter weather, only a few being strong enough to withstand the cold. These few creep into cracks or crevices where they spend the time sleeping. nearly all moths and butterflies make a cocoon pass the winter in the pupa stage, the the larva of the Isabella tiger moth and the mourning-cloak butterfly being exceptions, for they are sometimes seen while snow is on the ground. The beams on the underside of an old bridge are a favorite hiding place for the mourning-cloak, and there, with folded wings, she may sometimes be found in midwinter.

Insects like the cricket and grasshopper deposit their eggs in the ground among the fine roots of grasses. Beetles pass the winter in the larva or grub stage, hidden in the ground. The May-fly and dragon-fly deposit their eggs in water, while many other insects lay theirs in the buds or under the bark

The larvæ of
or chrysalis and
woolly-bear or



ASTERIAS CHRYSALIS
From Miss Dickerson's
"Moths and Butterflies"

of trees. Many insects live through the season in the larva stage, but the greater number die, leaving eggs to perpetuate the species. These eggs differ greatly, especially in size and color. Some of



CECROPIA COCOON

From Miss Dickerson's "Moths and Butterflies"

them are soft, some are covered with a tough substance, others with hairs, with a real shell, or with a kind of froth, each egg having a covering adapted to the climate in which the insect lives.

As material for study collect cocoons and chrysalides from trees, fences, etc.; all kinds of galls, such as oak, rose, leaf-galls, willow, goldenrod, etc.; and the eggs of the tent caterpillar (often found on the wild cherry tree). Directions for keeping a colony of ants may be found in Hodge's "Nature Study." Earthworms may be kept in a box of moist soil. Cocoons containing spider's eggs may be found on the underside of stones, fence rails, etc. The spider will live for some time if confined in a glass jar covered with netting. Two or three twigs should be placed in the jar to provide a place for the attachment of the web. As long as the spider is thus confined he must be supplied with live flies for food. Caterpillars, such as the woolly-bear, asterias, etc., may be kept in a wire-covered box if provided daily with fresh food (the leaves of the plant on which they are found). The eggs of any insects that can be found may be kept in a cool place until it is time for them to hatch.

WHERE TO FIND MOTHS AND BUTTERFLIES

If you would get in touch with the development of some of the beautiful mysteries of life, you need to become a "bug hunter." You must raise moths and butterflies so as to appreciate the variations in the different stages of insects. In order to get material for such study you need only to find some place where the underbrush has not been cut along the roadside or the edge of woods. Neglected fields and old gardens also are excellent places in which to hunt for eggs, larvæ, or the perfect insect. A low growth of wild cherry is often the hiding place for many specimens. On the bark you may find the red-spotted purple butterfly, while the underside of the leaves may hold colonies of larvæ of the io, or conceal the blue promethia or tiger swallowtail. The cecropia is sometimes found on the same tree, or it may be found on the

apple tree. The birch tree may be the hiding place of the luna moth, while the cocoon of the cecropia is frequently found on the ground, hidden among the fallen birch leaves. The parsley plant will yield the asterias caterpillar, and the milkweed the monarch. The hillside weed, everlasting, is the favorite hiding place of the



ASTERIAS BUTTERFLY

From Miss Dickerson's "Moths and Butterflies"

painted beauty, and the red admiral may often be found within the folded leaves of the nettle. Any place where there is a tangle of grapevine or woodbine is worth searching with the expectation of finding a giant sphinx.

If in your search you succeed in finding a female moth or butterfly, you can easily secure the male by the following simple

device. Secure the female in a box covered with netting and place the box on the piazza or near an open window. In some natural way the male will discover where she is and come to the box, and then he can easily be captured. Sometimes as many as half a dozen will visit the box at the same time.

If you have taken pleasure in collecting and studying insects, you will be interested in the stories of how the bee, wasp, ant, and spider live and work, and how some of the most injurious insects were introduced into this country.

GALLS

Galls are peculiar growths or swellings that appear on stems or leaves of certain plants. The largest and most familiar of these are the oak-apple, the pine-cone found on the willow, the spindle-shaped gall of the goldenrod, and the mossy-rose gall which grows on the stem of the sweetbrier. They are made not only by the true gall-fly but by



MOURNING-CLOAK BUTTERFLY
From Miss Dickerson's "Moths and Butterflies"

mites, plant lice, flies, beetles, etc. The female deposits an egg in the tissue of the leaf or stem. When the larva hatches, the tissue swells, forming the gall. In some cases the gall begins to grow as soon as the insect has deposited its egg in the tissues of the leaf or stem; in others the gall does not appear until the larva begins to feed. The oak-apple is made by the gall-fly, a small four-winged insect. The egg is laid in the soft tissues of the leaf. As soon as the larva commences to feed, the leaf tissues begin to swell and

grow around the larva in such a way as to cover it completely in a short time. The growth thus serves to supply the larva with food and shelter. It is thought by many that the growth of the gall is due to a poison given off by the parent insect or by the larva — by the former when the gall begins to grow as soon as the egg is deposited, and by the latter when the growth does not take place until the larva begins to feed.



OAK GALLS

From A.W.Gould's "Mother Nature's Children"

If a fibrous oak-apple is opened, a little cell is found in the center containing the larva. The space between the cell, or kernel, and the outer covering is filled with fine threads or fibers, which extend in all directions from the cell to the covering. In the fresh oak-apple the cell is surrounded by a soft spongy mass. The larger empty oak-apple contains but few fibrous threads, and the tiny hole perforating the outside tells where the prisoner made his escape.

In the case of the pine-cone willow gall the insect deposits its egg in the bud at the end of the twig. The poison from the larva

stops the growth of the stem, without entirely stopping the growth of the leaves. Because of this, the imperfectly developed leaves grow to form the scales of the cone. The gall found on the sweet-brier consists of a large number of hard kernels that surround the stem and are covered with moss-like threads.

Galls made by mites and plant lice have an opening on the underside of the leaf, so that the young can escape; but in the galls made by the gall-flies there is no opening except that made by the insect when it escapes. There are some kinds of gall-flies that remain in the gall until the perfect insect has developed. In other cases the larva, when fully grown, leaves the gall and enters the ground to complete its transformation.

INSECTS IN THEIR RELATION TO MAN

Flies, fleas, mosquitoes, yellow-jackets, clothes-moths, carpet bugs, and other insects have, by the spread of disease or by their destructive work, become pests and nuisances. The bot-fly and tsetse fly are insects that are injurious to animals, while the cut-worm, squash bug, plant lice, wood-borer, tent caterpillar, potato bug, codling moth, bark lice, and locust are injurious to vegetation. Among the insects that are indirectly useful to man are the bees, moths, butterflies, and other insects that fertilize flowers. The silkworm, honey-bee, cochineal insect, and the lac-insect are among the few that are directly useful to man in other ways.

There are certain insects, like the fly, flea, and mosquito, which it would be impossible to prevent migrating, since they secrete themselves not only in all kinds of vessels entering our ports, but in all kinds of goods shipped to this country. The greater number of insects injurious to vegetation are those that come here packed in seedlings and plants shipped to nurseries. This could

be prevented if laws should be passed by the United States government requiring a careful examination of all plants shipped to this country.

Among injurious insects introduced in the way just mentioned, which have later become pests in this country, is the brown-tail moth. About this Mr. Marlett gives us the following facts: "The present effort to secure legislation resulted from the discovery two years ago of the introduction of enormous quantities of brown-tail moth nests, full of hibernating larvæ, on seedling fruit stock, chiefly from northern France. With these were occasional egg masses of the gypsy moth. During the year 1909-1910 such infested stock was sent to no less than twenty-two different states, covering the country from the Atlantic seaboard to the Rocky Mountains. During the first of these years no less than seven thousand winter nests of the brown-tail moth, containing approximately two million eight hundred thousand larvæ, were found in shipments to New York alone — seed material enough to infect the whole United States within a few years."

The introduction of the gypsy moth happened in this way: "The gypsy moth was probably introduced by a professor connected with Harvard Observatory, who was interested in breeding silk-producing insects. The larvæ escaped from his garden at Medford, near Boston, and though search was made for them, not all were found. Nothing was heard from them for fifteen years, when they began to be troublesome in gardens. By 1889 they had multiplied to such an extent that they attacked every green thing, and the bare branches of trees in every direction gave evidence of the extent of their destructive work. In this year the insect was identified. Up to that time it had been called simply 'the caterpillar.' First the town of Medford, and then the state, took up the matter, and the first state appropriation of twenty-five thousand

dollars was passed. Since that time additional appropriations have been called for in the effort to exterminate the insect.”¹

The story of the introduction of the lady-beetle for the purpose of protecting the orange trees of California is told by Mr. Clarence M. Weed as follows: “A few years ago a very destructive scale insect appeared in the orange groves of California. The owners feared they would lose all their trees and were very much discouraged. They consulted Dr. C. V. Riley, who undertook to discover a remedy for the trouble. He first found out, by means of much writing and looking up of papers, that the insect called the ‘cottony-cushion scale’ had come to California on trees imported from Australia. He next learned that in that country the scale did very little damage, so he concluded that in its native land it must be kept in check by some natural enemy. Acting on this suspicion he sent a young man to Australia to examine into the matter, who soon found that it was the larvæ of two or three lady-beetles that kept the scales from multiplying. The difficulty was to bring them alive to this country, as the danger was that they would starve or become diseased on the long voyage. However, after a few unsuccessful attempts, a small number reached California alive and were placed on some scaly orange wood, where they began at once to eat up the bark lice. They were carefully guarded and seemed to do well in their new home. As soon as enough of them had been bred they were distributed to all parts of the state where they were needed, and very soon the cottony scale began to diminish in numbers and the orange growers grew hopeful. In the course of two or three years the crops of fruit again became enormous and brought great wealth to the state, and all through the agency of a tiny red-and-black beetle and its greedy larvæ.” The lady-beetle is also known by the name lady-bird, or lady-bug.

¹ H. R. Linville and H. A. Kelley, “A Text-Book in General Zoölogy,” p. 89.

The house fly has always been considered an annoyance and a nuisance, but not until recently has it been known that the fly was able to carry the germs of typhoid fever. Breeding as it does, wherever garbage or manure is allowed to remain uncovered, it swallows many kinds of germs and spores. All that the fly eats passes through its body in less than an hour, and in the black specks deposited by the fly these germs and spores are found alive and uninjured. If allowed to enter the house and travel over the food and dishes, or to alight on our faces and hands, these germs may be left in a position to do great harm. The best means of prevention is to screen the houses, and to screen or cover all places where the fly might deposit its eggs.

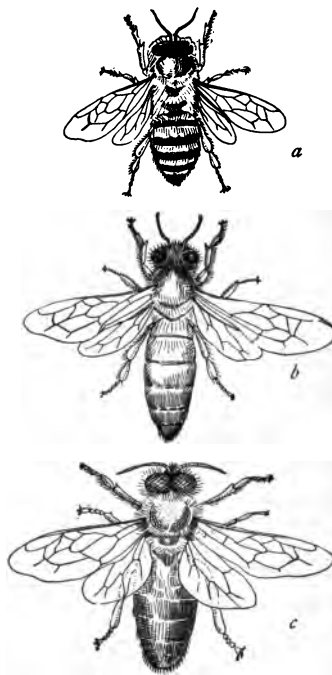
The mosquito is another insect that is feared on account of its power to spread the germs of malaria and yellow fever. The mosquito can be exterminated by draining the swamps and ponds where they breed, by pouring kerosene oil on the surface of the water, — an ounce to fifteen square feet of water is the amount required, — or by introducing fish that feed on the larvæ

THE BEE

The peculiar industrial habits of the bee were known at a very early time. This is shown by the fact that Moses speaks of the bee, and in the picture writings on the obelisks and monuments of Egypt the hive bee is used to represent Lower Egypt, and the queen bee to picture royalty. From the fact that the Promised Land to which Moses was to lead the children of Israel was described to him as a "land flowing with milk and honey," it has been supposed by many that Palestine must have been the original home of the honey-bee. It is a well-known fact that the black or German bees were first brought to this country by some of the early English settlers, and that later many of these bees escaped

and became wild. But it is not known certainly whether this is the origin of all wild bees found in the United States.

A colony of bees consists of a queen, known by her great size, the drones, and the workers. In early summer the colony, if in good condition, may contain from twenty to thirty thousand workers, several hundred drones, or males, and a single queen. All the work in a colony is done by the workers. They secrete the wax from which the walls of the cells are formed. They collect the nectar from the flowers and later make it into the honey with which the cells are filled. They collect the pollen and mix it with the nectar to form the bee-bread, and they bring water to the hive. When the larvæ are hatched the workers feed them and keep the hive clean. If the weather is warm, they stand at the entrance and in the passageways, and by the rapid movement of their wings keep a current of air moving through the hive. If any danger threatens, the workers fly out, and by their numbers and formidable sting protect the hive.



HONEY-BEES

a, worker; *b*, queen; *c*, drone

From Hodge's "Nature Study"

As a rule the queen honey-bee lives about three years, the worker from five to seven weeks. Some of the drones are driven from the hive and allowed to starve to death, and others are killed off by the workers either because there is a scarcity of nectar in the

flowers, or because they are no longer needed. The queen honeybee devotes herself to laying eggs, and during the height of the season she has been known to lay as many as three thousand in a single day. The eggs that are to develop into workers are placed by the queen in cells of ordinary size, while those that are to become drones are placed in cells that are slightly larger. When the workers wish to develop a queen, they enlarge one of the small cells, and in this enlarged cell they leave one egg that would ordinarily develop into a worker. When the egg hatches, the grub, or larva, differs in no way from the other grubs. The workers feed this little white grub with a specially prepared food known as "royal jelly," because they know that this nourishing food will cause such a physical change in the grub as will result in the development of a queen. After feeding her for a certain number of days with this "royal jelly," the workers seal up the cell and leave her alone to change to a pupa, confident that in due time a queen bee will come forth.

If the season furnishes an abundance of nectar so that the work in the hive has prospered, the increase in the number of bees forming the colony makes it necessary for some of them to seek a new home. When the hour comes for them to leave, they take the queen with them. Wherever the queen alights she is quickly surrounded by the other bees. If a new hive is given them, they will quietly settle in their new home. This is what is called the "swarming" of the bees. Frequently as many as three swarms will leave a hive in a season, the number depending on the size of the community.

Wild bees make their home in hollow logs, trees, and crevices of rocks. The bumblebees are wild, and differ from the honeybees in that they never swarm, and that the honey they make is strong-smelling. When the cold weather comes the workers and drones die and only the queen survives.

As early as 1773 the honey-bee had been introduced into all the colonies, and the wax and honey were used as articles of barter when money was scarce. In 1780 the bees of Kentucky had become famous for their fine quality of honey, but it was not until 1797 that bees were carried west of the Mississippi River. For a long time it was believed that the only way to collect honey was to kill the bees, tear open the hives, and take out everything — honey, larvæ, young bees, and pollen. When the movable-comb hive was invented in 1852, it was found that the keeping of bees could be made a profitable industry, as this made it possible to save both bees and honey. In 1875 the section honey box was invented, thus increasing the profit of beekeeping by providing an attractive means of preparing honey in small quantities for market. Among the blossoms from which bees gather most of the nectar used in making honey are the white clover, buckwheat, goldenrod, raspberry, blueberry, and huckleberry. In the South the bees are specially fond of the palmetto, cotton plant, tupelo, and sumac blossoms, while in the North the blossom of the basswood attracts them through the large quantity of nectar it yields. In California the mountain sage is eagerly sought by the bees, and a single hive usually yields from seventy-five to two hundred pounds during the season.

Beeswax is another valuable product obtained from the honey-comb of bees. The comb is first drained of all honey; then the wax of which it is made is cleansed and melted by being placed in boiling water. As it melts it rises to the top of the water and is skimmed off into molds to harden. When first made the wax is yellow in color, but it can be bleached by being cut into thin slices and exposed to the air, light, and moisture. It is chiefly used in the manufacture of candles, dolls, soap, and in the preparation of certain medicines. A great deal of beeswax comes from Cuba, Haiti, Abyssinia, and Madagascar.

THE WASP

Wasps may be divided into two groups : those that live in colonies, or social wasps ; and those that live alone, or solitary wasps. Among the social wasps some build nests not over two inches long and an inch and a half in diameter ; while others, like the hornet, build nests that are a foot and a half in diameter.

In the early spring the female, the only member of the colony that lives through the winter, having selected some sheltered spot for her nest, goes to some old rail or stump to gather wood with which to build. When she has found a bit of wood that suits her purpose, she gnaws lengthwise of the grain until she has filled her jaws with a little bundle of wood fibers. Carrying these to her chosen home, she chews them into a fine pulp which she mixes with a saliva from her mouth. As her little house is to hang suspended by its roof, she first makes the slender stem that is to hold it in place. To the end of this support she fastens a cluster of three or more cells. The first cell is circular in shape, but when the other cells are attached to it, their pressure, one against another, makes them, and all others that are added, hexagonal (six-sided). She moistens the fibers of wood with the saliva from her mouth so as to fasten them together and to make the material waterproof. In addition to this she sometimes covers the whole outside with a varnish made of the same saliva. Although the cells are built so that they hang with the open end downward, neither the egg nor the larva falls out—the egg because it is securely fastened at one end with a sticky substance, the larva because it fastens itself to this same spot by grasping the cell with the two little feet at the end of its tail.

The nest of the social wasp is always kept free from dirt and in perfect order. The air within the nest is kept pure by captive

wasps, who are stationed at the opening to keep the air in motion by fanning it with their wings. The social wasps also keep sentinels, whose duty it is to watch the entrance and defend the nest when danger threatens. In the early spring or summer the social wasp lives largely upon nectar. Later in the season it eats the pulp of certain attractive fruits and sucks the juices of others. Sometimes it kills other insects, being especially fond of flies. Although the wasp has no separate honey-sac like the bee, it gathers nectar with which to feed the larvæ, carrying it in its stomach to the nest.

Nests of solitary wasps are found in a variety of places. The peculiar name given to the different species of these wasps is probably derived either from the material of which the nests are made, or from the manner in which they are constructed. The mason wasp builds nests of clay mixed with saliva. As soon as one cell is finished it is filled with insects. Upon one of these the egg is deposited, and the cell is then securely closed with mud. Three or four cells are built side by side, and other cells are built above these so as to form two or three layers of cells.

The carpenter wasp burrows into logs or boards, making a hole large enough to hold the egg and the necessary food supply. Miners prefer to make their nests in the ground, where they dig tunnels in which to deposit their eggs. Another little wasp builds its nest in the form of a tiny vase. In "Sharp Eyes" William Hamilton Gibson speaks of them as "brownie jugs," and says: "I have seen many a jug catalogued in a bric-a-brac sale that did not have nearly so interesting a history as one of these clay pots of the vase-maker wasp. It is made of sand and yellow mud. When completed, the wasp lays an egg within it and then proceeds to pack it full of tiny green caterpillars, each of which she has paralyzed, though not killed, by a stab of her sting. The

opening of the vase is then plugged up with a mud cork. Presently the egg hatches into a little grub that feeds for the rest of its days on the living store of food. By the time the supply has run short the grub has become a chrysalis, and soon pushes out the plug and appears a full-grown wasp, like its parent, and it will

make as pretty a jug as the one it leaves, the first time it tries."



MUD WASP'S NEST

From A. W. Gould's "Mother Nature's Children"

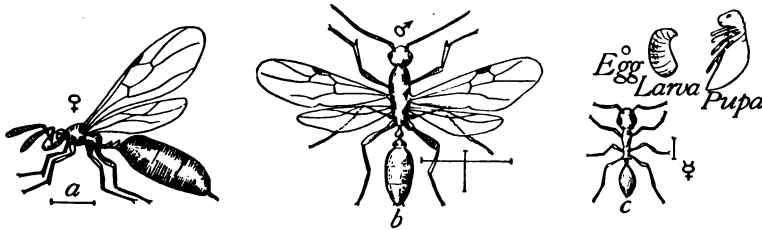
All solitary wasps fill their nests with some form of animal food on which they deposit their eggs, so that when the eggs hatch, the larvæ will have food enough to last until they have reached their full growth. Among the insects selected for this purpose are flies, bugs, beetles, grasshoppers, and caterpillars. Each cell

is filled with insects that have been stung in such a way as to make them perfectly helpless without killing them. All insects left in a single cell are of the same kind.

THE ANT

The ant has been considered a model of industry ever since the day when King Solomon said, "Go to the ant, thou sluggard; consider her ways, and be wise." Their social life and work is more complex than that of the bee or wasp, for each colony consists of males, females, workers both great and small, and soldiers. From the fact that the soldiers are organized into armies and fight great battles, that they keep their cows and plant lice, and that

certain species capture and carry home slaves to do the menial work in the nest, shows that in many ways the ant is more remarkable than any other insect. At first both males and females have wings. After the "marriage flight" the males soon die, and the females tear off their wings and never again leave the nest. The females can be distinguished from the others by their great size



THE LITTLE BLACK ANT

a, female; *b*, male; *c*, worker: egg, larva, and pupa. (All enlarged. After Marlatt)
From Hodge's "Nature Study"

and well-developed simple eyes. The queen and workers may live for a long time, as is shown by the fact that Sir John Lubbock kept some from 1871 to 1875.

Some ants make their nests entirely underground, others make them partly above and partly below the level of the ground. Still others tunnel into wood or eat into the trunks of trees. Some ants collect in large quantities bits of sticks, leaves, and the like, which they heap together in the form of a mound. Other mounds are formed of little pellets of dirt, which the ants bring up out of the ground while digging their burrows. The eggs are extremely small, and for this reason are difficult to find. When an ant's nest is disturbed the workers are frequently seen trying to escape, each carrying one small, white oval object, commonly called "ant's egg." Instead of being eggs they are the pupæ of the ant. The

pupæ are sometimes naked and sometimes covered with a silken cocoon. Both the larvæ and pupæ are tenderly cared for by the workers, who carry them from chamber to chamber in order to find the proper amount of heat and moisture. The skin of very young ants is so soft and tender that they are not fitted to do any hard work, and for this reason they remain within the nest until the skin becomes hard, and during this time devote themselves to taking care of the larvæ and pupæ.

The food of ants consists principally of fruit, honey, "honey-dew," a sweet fluid they secure from aphids, and insects, great numbers of which they destroy. Ants are armed with such strong biting jaws that they are able to destroy animals much larger than themselves. Sir John Lubbock tells of their killing a snake four feet long, and a great python that had gorged itself with food.

Ants have many enemies. They are frequently attacked by mites, and by one species of fly that lays its eggs on them, in order that the larvæ may feed on the juices of their bodies. Certain birds and grizzly bears eagerly seek them for food. With so many enemies it is not to be wondered at that they are great fighters. They also wage war for the purpose of capturing other ants that they carry home to serve as slaves. There is one species of ant that has a very hard, tough skin, and when attacked rolls itself into a ball instead of fighting, and at the same time gives off a very disagreeable odor, which probably serves as an additional means of protection. It also makes the entrance to its nest so small that a single worker can block the passageway with its head. Other species fold their antennæ and legs closely against their sides and "play dead" when an enemy appears. Many others, depending upon their numbers and the strength of the jaws of the individual members, will fight long, fierce battles.

Ants are a very common pest in houses. Those that give the most trouble are the little red ant, the little black ant, and the pavement ant. They are not destructive, but owing to their fondness for sugar, sirup, and other sweets they are always "getting into" foods of this kind. The only way to rid a house of them is to find the nest and destroy it with bisulphide of carbon or kerosene.

Although the ant is generally looked upon as a pest, there are certain countries in the Old World where they are a source of commercial value to man. We find that in Siam ant's eggs are considered a very choice article of food, while in some of the northern countries of Europe they are an object of important trade, on account of the vinegar or formic acid they yield after being cooked in boiling water.

SPIDERS

These little creatures are found in nearly every locality and differ in many respects from the true insect. They have a body that is divided into two parts instead of into three, like the insect. They have four pairs of legs instead of three; no wings; eight simple eyes and no compound eyes; two jointed mandibles or jaws that discharge poison at the tip; three pairs of spinnerets at the end of the body; and the habit of spinning cobwebs and silk cocoons for their eggs.

When the spider is ready to lay her eggs, she first spins a little web on which to deposit them. Then she covers them with silk, forming a cocoon. Some spiders take care of their cocoons until the young are ready to come out, others go away and leave them unprotected. After the eggs hatch, the young remain in the cocoon for some time, and if they are hungry they frequently feed on each other. The cocoon may contain from five hundred to two thousand

eggs. Those that are laid in the summer are ready to hatch in two weeks, while those that are laid in the autumn take all winter to develop. The spider differs from the true insect in that it does not undergo complete metamorphosis, that is, does not exhibit four distinct changes of form — egg, larva, pupa, and imago or perfect insect. When the egg hatches, the young resembles its parent. Its growth is rapid, and its skin is shed frequently as long as its body is increasing in size.

The larvæ of moths and butterflies have mouth parts provided with tubes for spinning silk with which to make their cocoons or mats to which they fasten the pupæ. The spider, however, is provided with a special set of organs at the end of its body for the spinning of silk. These spinnerets end in little tubes from which the liquid comes that forms the threads. As the liquid comes from the tubes it consists of many fine threads which are soft enough to unite to form a single thread such as is seen in the cobweb. This silk is spun by the spider for several purposes. As we have already seen, the spider uses it to form the covering for her eggs. Some spiders spin large webs for the purpose of capturing insects in order to suck their blood. Spiders that live under stones or on plants have the habit of lining their hiding places with this silk. Those that dig holes in the ground nearly always line them with silk, or use it as a means of escaping from or returning to their nests.

The jaws of spiders are armed with claws that are used for killing and crushing insects, the soft parts of which are then sucked for the juice or blood. At the end of the claw is an opening through which a poisonous secretion is discharged. The rapidity with which the spider can hide within its nest seems to be its chief means of protection. An examination of the eyes of a number of spiders will show a variation in the way they are arranged. This arrangement

of the eyes is the chief distinguishing characteristic of the different members of the spider family.

Spiders can live in the driest and warmest places, as well as on very high mountains and near water, on the surface of which they are accustomed to run. When the cold season approaches and the spider can no longer find food, it hides away among the leaves or in some crack until the warm weather returns.

The silk spun by the spider is finer, smoother, and brighter colored than that of the silkworm. Efforts have been made to find a use for this silk, but experiments have shown that it would cost so much to provide "the space for keeping each spider by herself, and the amount of labor needed to draw out the silk, and to provide them with living insects for food," that it would make this silk too expensive for common use.

Summary. 1. How do invertebrates differ from vertebrates? 2. What are the distinguishing characteristics of insects? 3. Which insects are considered most valuable to man? Why? 4. What should be done for such insects? 5. Which insects are considered most injurious to human life? Why? 6. What should be done to such insects? 7. Which insects are most injurious to vegetation? Why? 8. What should be done to such insects? Why?

CHAPTER XI

WORMS

SPECIAL STUDY OF THE EARTHWORM

Fill an aquarium with fine sand or garden soil and in this place three or four earthworms. When they have become accustomed to their new surroundings, scatter some grass or dried leaves on the surface and cover so that the moisture will not evaporate. As the earthworms work chiefly at night, it is better to make your observations then, using as dim a light as possible so as not to disturb them.

Earthworms may be kept without injury for several days in a glass jar of water, if the bottom is covered with fine sand. Since these worms breathe through their skin, and it must be kept moist so that they can breathe freely, this treatment is not so cruel as it may seem. The eggs of the earthworm are very small and are done up in a kind of capsule about the size of a mustard seed. These capsules may be found near the mouth of the burrow during the month of June. If the eggs are placed in a small covered glass dish, they will soon hatch. By adding a little moist earth after the earthworms hatch, and providing leaves for food, they may be kept for study as long as desired.

Examine the outline of classification (p. 190) and determine the distinguishing characteristics of the earthworm. Under a sketch of the earthworm make a record of these characteristics.

Observation work. Examine several earthworms and determine the number of divisions in the body. What peculiarity do you

notice about the skin between each division? Observe the two ends of the body and note the difference between them. Watch the worm move. Can you note any change in the size of the body when it is pulled up, or when it is pushed forward? What do you infer from this? Watch it eat. Can you discover its lips? Make a record of the facts that show the adaptation of the worm to the place where it lives; to the way it moves; the differences in the anterior and posterior ends; how and what it eats.

Leave the aquarium undisturbed for six weeks, then examine the surface to note the changes that have taken place in the soil. What differences in color do you notice? How much of the dark-colored soil is there? What has become of the leaves? From what do you infer that the dark soil, or humus as it is called, was made? How? Make a record of these facts in the form of a description. Make a list of other worms.

Having finished your observations, you will enjoy learning what has been discovered about the life and work of the earthworm.

THE EARTHWORM

If you have ever enjoyed the fun of fishing, you have undoubtedly made the acquaintance of the earthworm. Since this worm is to be found in nearly all places where the soil is not too cold, too dry, or too sandy, it is much sought by fishermen as bait for their fishhooks. Perhaps as you pulled one from the loosened soil you noticed the long, tube-like body without realizing that this was composed of from one hundred to two hundred rings or segments; that across each of these divisions was a wrinkle or fold of skin which made the number of rings look double what they really were; that on each ring of the body, except the first, second, third, fourth, and last, were four pairs of minute bristles that pointed backward.

Although the earthworm has no true head, there is quite a difference between the two ends of the body. The front, or anterior end, is somewhat pointed. The mouth parts are located at this end and consist of two lips, the upper one being a little longer than the lower one. The mouth opens into a pouch which can be pushed forward while eating, like a snout or proboscis. The posterior end is somewhat flattened instead of being pointed.

Within the body of the earthworm are two sets of muscles, one running around, the other extending lengthwise of the body. When the earthworm crawls he draws up the body by contracting the muscles that run around it, then he stretches the longitudinal muscles so as to push the body forward. By means of the contracting and stretching of these muscles he is able to move either forward or backward. When the worm commences to dig his burrow, he first inserts the anterior end of his body like a wedge in some crack or crevice in the ground, and then pushes his pouch or pharynx forward into this opening. The walls of the pharynx are very thick and muscular, and when the worm pushes forward they swell, and he is able to push away the dirt on all sides.

Earthworms dig their burrows to some depth, going as far as six or eight feet if the weather is very dry or very cold. After the worms have reached a certain depth the earth will not yield to the slight pressure they are able to exert in their efforts to push it aside, so the work of excavation must be carried on by the worms in a different manner. They do this by first swallowing the earth, passing it through their body, then backing out and leaving little pellets of earth, or worm castings, near the mouth of the burrow.

The deeper burrows frequently end in a little chamber in which several worms, rolled up close together, will sometimes pass the winter. Some burrows are lined with a thin layer of fine,

dark-colored soil, specially prepared for this purpose by the worm. This lining is smooth and compact, and fits closely to the body of the earthworm. It is probable that this lining is to help make the walls stronger and keep the worms from being scratched.

The little chamber at the end of the burrow is usually lined with seeds or little stones to keep the earthworms from touching the cold earth. An additional lining of leaves is often placed about the mouth so as to protect them from the cold when they come to the entrance to enjoy the sunshine. When the worm retreats into its burrow it frequently closes the entrance by plugging it with leaves.

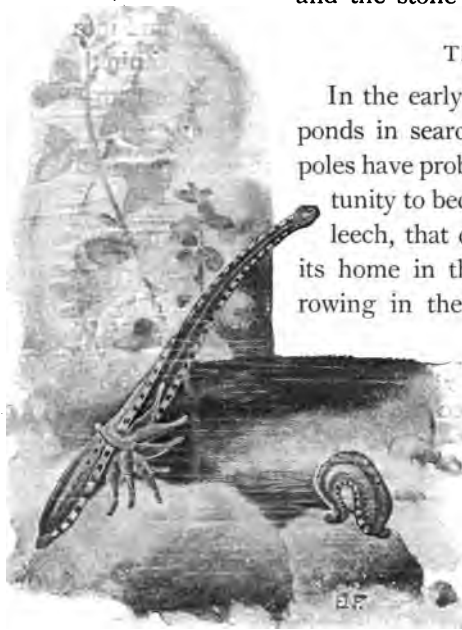
Earthworms seek their food at night, and feed upon decaying leaves and earth matter which is swallowed for the sake of the nourishing materials it contains. Crawling to the mouth of the burrow, they cling there by their tails while they stretch their bodies out over the ground in search of leaves, which they suck and pull in with their lips. Before the leaf is dragged into the burrow the earthworm moistens it with a fluid from its pharynx. This quickly kills and discolors the leaf, causing it to decay and making it softer and easier to digest. The fact that fresh castings are seen at the mouth of the burrow day after day, and that on the day when they are thrown out in greatest numbers few if any leaves are drawn in, shows that the worm must have found earth containing an abundance of food. The castings would have been found only occasionally instead of day after day, had they been thrown out only when the worm was digging its burrow.

From Darwin's study of the earthworm we learn some interesting facts about the wonderful work done by these worms in improving the soil. The dark color of the topsoil is due to the mixture of partially digested leaves and earth. The greater the amount of leaves eaten by the worm the darker the soil. The number of

burrows made and the depth to which they extend help to prepare the ground for the growth of the delicate roots of plants and seedlings. The castings found at the mouth of the burrow show that the earthworm is constantly at work bringing up to the air particles of soil that have been mixed with the fluid given off by its body. Since all this material passes through the body, it must necessarily be very fine, and sifted of all stones larger than the worm can swallow. This sifting helps to keep the earth in good condition to hold moisture and to absorb such substances as can be dissolved by water. The loosening of the soil and the presence of many burrows allow the air to pass deep down into the ground, while the material with which the burrows are lined provides nourishment for growing plants.

Estimates made by Charles Darwin show that the whole mass of dark soil which is spread over the surface of the earth passes through the body of the earthworm once in four years ; and that "the quantity of fine earth thus brought to the surface in the course of one year would in many places form a layer one fifth of an inch in thickness." To show how great a work the earthworm can accomplish he tells the following story about a field near his home : " For several years the field was clothed with an extremely scant vegetation, and was so thickly covered with small and large flints that the field was always called by my sons ' the stony field ' ; but the small stones disappeared before many years had elapsed, as did every one of the larger ones after a time ; so that after thirty years a horse could gallop over the compact turf from one end of the field to the other, and not strike a single stone with his shoes." He also tells us that "when a stone of large size and irregular shape is left on the surface of the ground, it rests, of course, on the more protuberant parts ; but worms soon fill up with their castings all the hollow spaces on the lower side, for they

like the shelter of the stones. As soon as the hollows are filled up, the worms eject the earth which they have swallowed beyond the circumference of the stone, and thus the surface is raised all around the stone. As the burrows are excavated directly beneath the stone, after a time they collapse and the stone sinks a little."



THE LEECH

In the early spring your visits to the ponds in search of frogs' eggs or tadpoles have probably given you an opportunity to become acquainted with the leech, that curious worm that makes its home in the water instead of burrowing in the ground like the earth-

worm. If, by chance, one of them clings to your hand, you will soon discover how they live, for nearly all the members of this family live by sucking the blood of fishes or other animals that live in the water. The body, instead of being tube-like, is broader at the

LEECH

From Linville and Kelly's "General Zoölogy"

posterior end and has a sucking disk at each extremity. Within the lips are three thick pads bearing several rows of very tiny teeth. It moves by first fastening itself securely by means of the sucker on the posterior end, then pushes its body forward by contracting

the muscles that extend around it. Having stretched as far as possible, it takes hold with its sucker-like mouth, loosens the other sucker, and draws up its body by contracting the longitudinal muscles. In this fashion it loops itself along instead of crawling.

When in search of food the leech fastens itself to the body of some animal by means of the sucker-like mouth. Its thin lips are brought together in such a way as to form a ring, and into this the flesh is sucked and then pierced by the tiny teeth within the mouth. The large food canal within the body is soon filled with blood. It is then mixed with a fluid from the worm's body, which prevents the blood from thickening and enables the leech to live for a long time on this store of food.

Many years ago bloodletting was a common remedy for a great number of diseases. At that time it was almost impossible to get enough leeches to supply the demand. The useful leech is found in central Europe, Asia Minor, and in certain places in northern Africa. At the present time leeches are frequently used. It is said that Germany and France use over thirty million a year, while at Bordeaux there is one farm of twelve thousand acres devoted to the raising of leeches.

Summary. 1. What distinguishes a worm from an insect? 2. In what respects does the worm resemble the larva stage of some insects? 3. How does it differ from the larva stage of all insects? 4. In what regions is it impossible for the earthworm to live? Why?

OUTLINE OF CLASSIFICATION

SUBKINGDOM	CLASS	SUBCLASS	ORDER
VERTEBRATES: animals having a backbone	Mammalia: all or partly covered with hair; bring forth their young alive	Monodelphia: those which bring forth their young in such a mature state as not to need the protection of a pouch	Primates: characterized by the possession of two hands and two feet; <i>ex- ample</i> , monkey
		Didelphia: those which bring forth their young in such an immature state as to need the protection of a pouch; <i>example</i> , kangaroo	Carnivora: flesh eaters
	Aves: body covered with feathers; fore limbs developed as wings		Ungulata: those that have hoofs
			Proboscidea: provided with proboscis; <i>example</i> , elephant
	Reptilia: body protected by epi- dermal scales or plates		Sirenia; <i>example</i> , sea cow
			Cetacea; <i>example</i> , whale
			Chiroptera; <i>example</i> , bat
			Insectivora; <i>example</i> , mole
			Rodentia: gnawers; <i>ex- ample</i> , squirrel
			Crocodylia; <i>example</i> , alli- gator
			Testudinata: having an external skeleton form- ing a carapace in which the body is inclosed; <i>ex- ample</i> , turtle
	Amphibia: gen- erally covered with a naked skin; having gills when young and true lungs when adult		Lacertilia; <i>example</i> , liz- ard
			Ophidia; <i>example</i> , snake
	Pisces: fishes		Anura: metamorphosis complete; <i>examples</i> , frog, toad
			Urodela: metamorpho- sis not distinctly marked, the tail being retained through life; <i>example</i> , salamander

OUTLINE OF CLASSIFICATION

SUBKINGDOM

CLASS

INVERTEBRATES:
animals without a
backbone

- Insecta: body divided into head, thorax, and abdomen: three pairs of legs, one pair of antennæ, and generally two pairs of wings; *example*, insects
- Arachnida: body generally divided into cephalothorax and abdomen; usually four pairs of legs; *example*, spider
- Myriapoda: many-legged; *example*, thousand-legged worm
- Crustacea: segmented body covered with a limy crust; numerous appendages, arranged in pairs; body divided into cephalothorax and abdomen; *examples*, lobster, crab
- Mollusca: soft-bodied, without internal skeleton and without joints, generally protected by a shell; *example*, oyster
- Annulata: body composed of segments; spines or suckers for locomotion; *example*, earthworm
- Echinoderma: marine animals like the starfish
- Cœlentera: *examples*, coral, jellyfish
- Porifera; *example*, sponges
- Protozoa: simplest forms of animal life

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